THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

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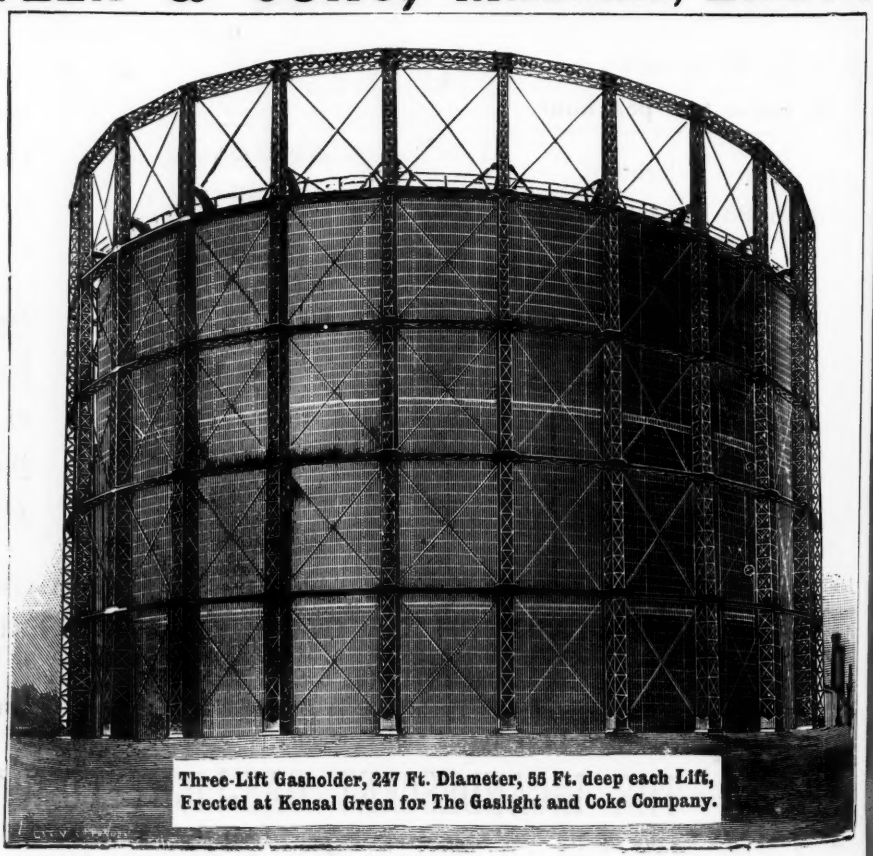

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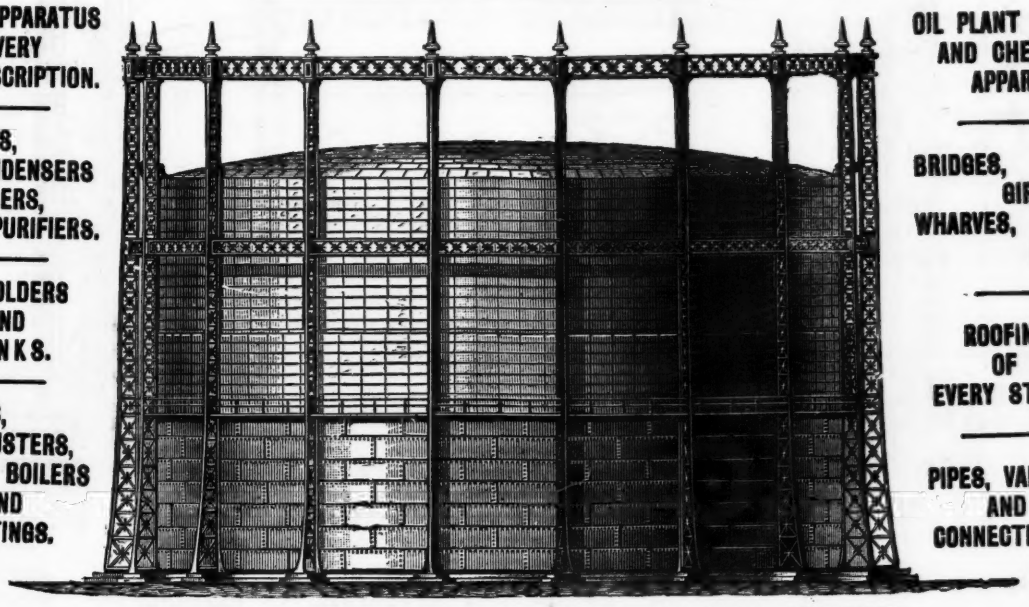

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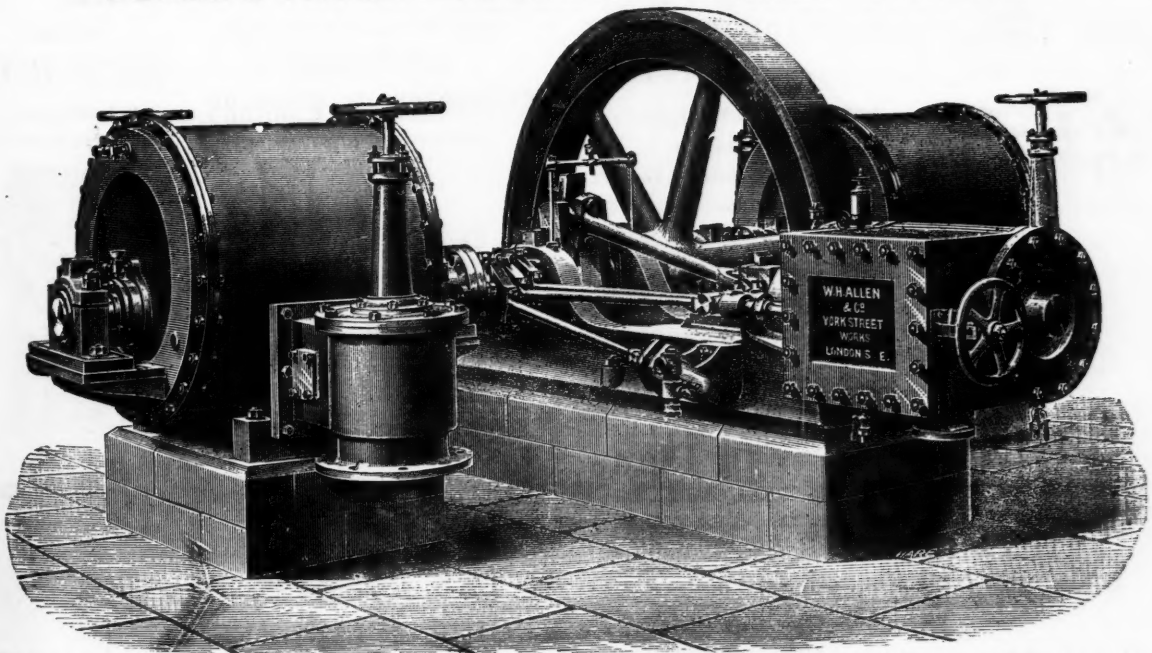

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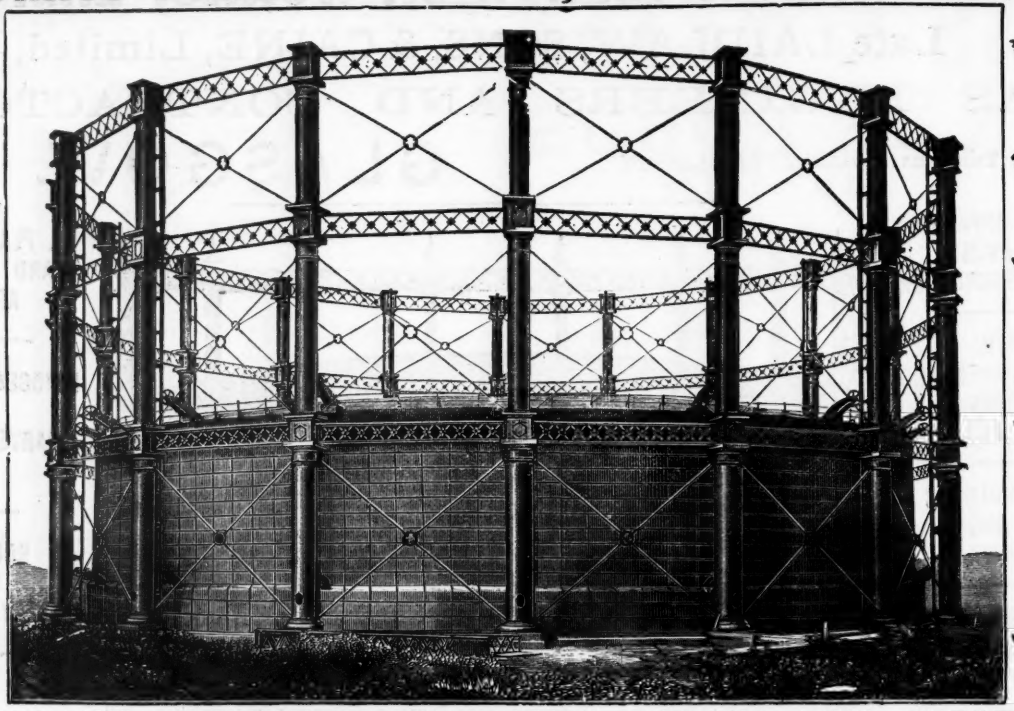

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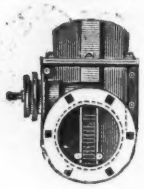

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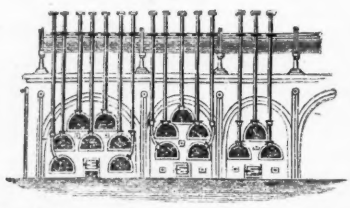

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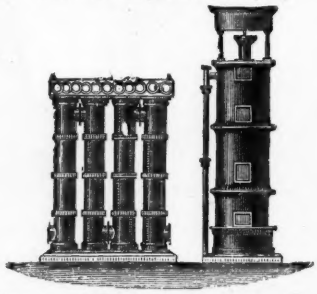

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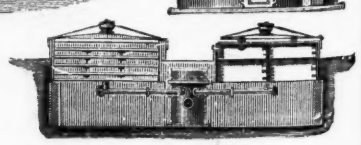

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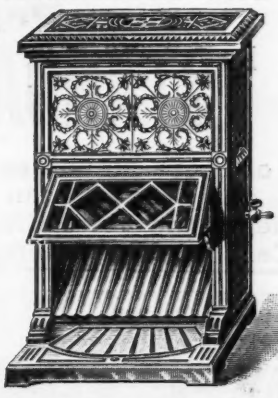

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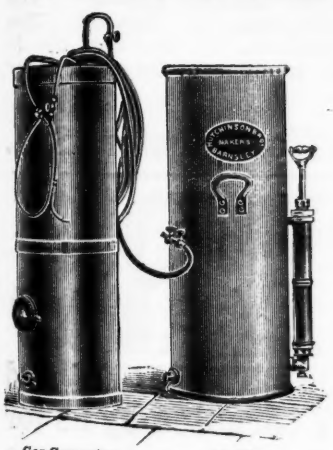

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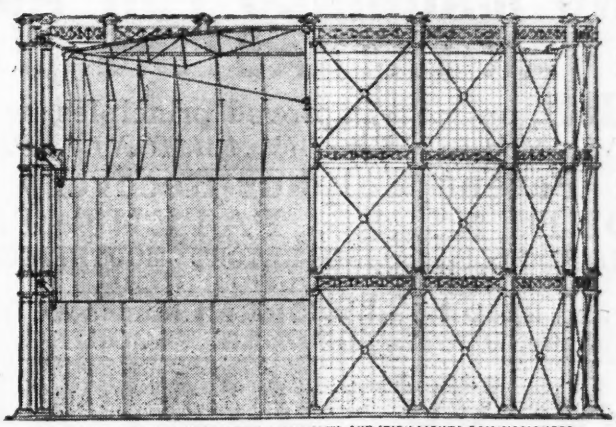

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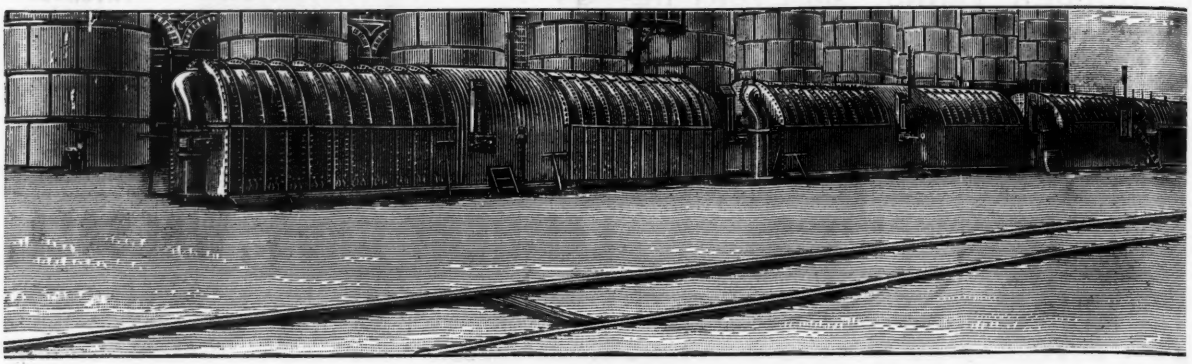

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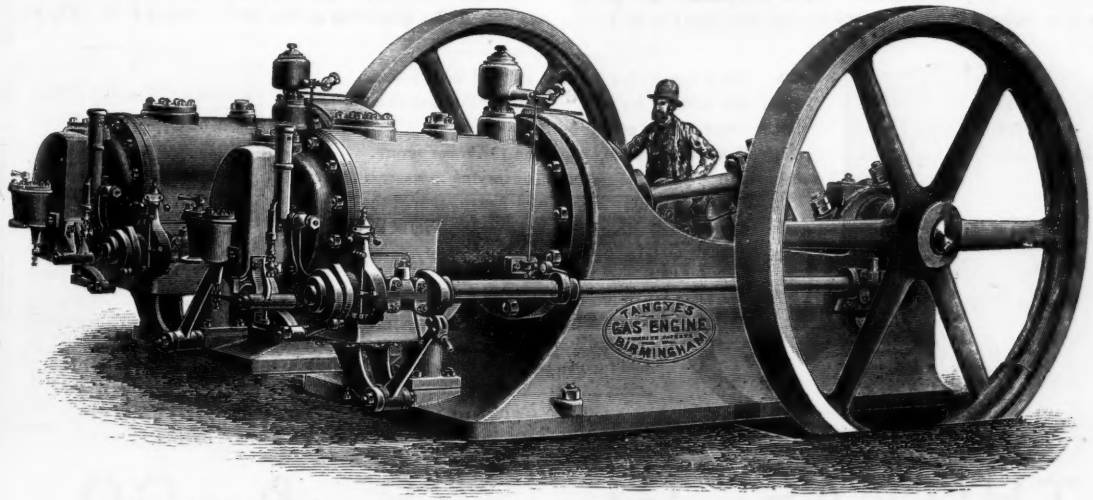

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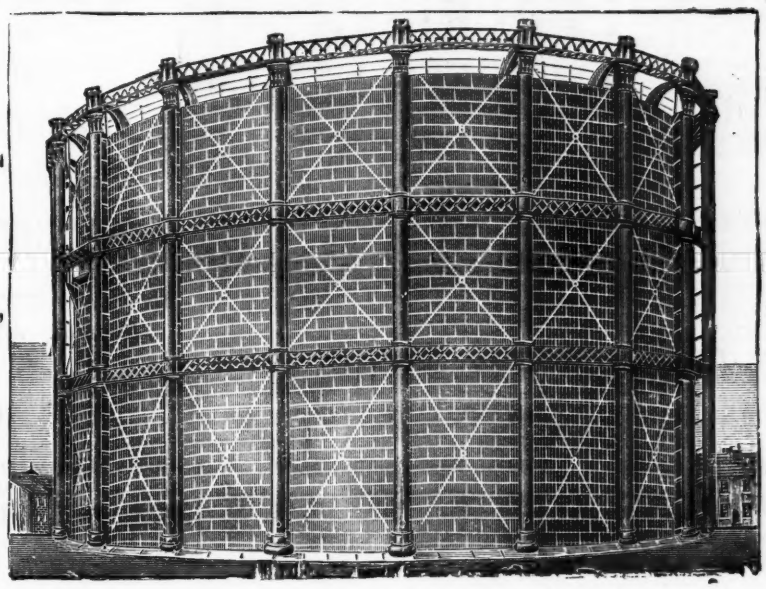

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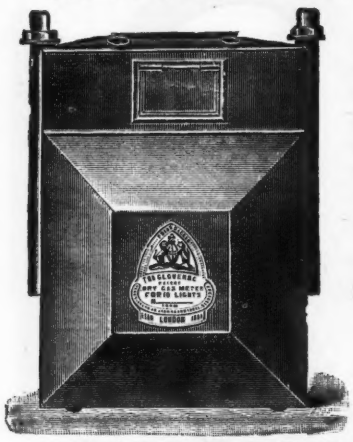

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JANUARY 9, 1894.

The Attack on the London Coal Ring.

WHEN the scheme of the late Sir George Elliot for re-organizing the coal trade of the United Kingdom as a Trust for the benefit of all concerned in it was first disclosed, it was greeted by the inevitable cheap criticism of the flippant Free Trader, who protested against any attempt being made to interfere with the "higgling of the "market" which is supposed to regulate retail prices in regard to coal as for other commodities. In London the *Daily News*, and various mouthpieces of Cobdenism in different parts of the country, joined in raising this parrot cry; and, meanwhile, the men who make the prices of coal for London must have chuckled at this fresh proof of the ease with which the British Public and its accredited representatives can "make believe." Here were all these professed teachers and disciples of Free Trade principles pretending that Sir George Elliot was little better than one of those wicked Protectionists for daring to suggest that cut-throat competition in coal getting might be disestablished; and completely ignoring the fact that every time they purchased a ton of coal in London they were playing into the hands of as arrant a "ring" as ever manipulated an important industry to their own excessive advantage. If the retail as well as the wholesale coal trade, at any rate as carried on in London and the South of England, were really governed by the sacred Cobdenite rule of free and open competition, there might have been some justification for these aspersions upon the nature of Sir George Elliot's scheme; but what are the facts? It has required the bold action of Colonel North, of Navigation Colliery fame, to exhibit the truth of this matter. Colonel North's men, to begin with, will have nothing to do with professional Trade Union agitators, for the simple reason that they work under a sliding scale of wages and prices with which they are content. Knowing, therefore, to a penny a ton what his coal will cost, delivered anywhere, Colonel North was able, when the Federation uproar broke out last summer, to offer to the London merchants a regular supply from South Wales which should go to reduce the distress certain to arise in the Metropolis in the event of a cessation of the usual supplies. The offer was declined; and the London dealers had the gratification of raking in 40s. per ton for worse coal than Colonel North would have enabled them to sell at 28s. per ton. Having started upon his new enterprise, however, Colonel North was not to be shaken off by the banded retailers; and he has accordingly for some time past been selling his coal direct to London householders at from 6s. to 8s. per ton less than the standard prices demanded by the "ring." Gas companies as well as the public may wish success to this movement; for the tyranny of dealers in the matter of coke is as monstrous as their action in regard to coal. If Colonel North holds out, the "ring" must go to pieces; but, in the meantime, what is to be thought of the action of the Marquis of Londonderry in supporting it? It is a scandal to see, in this country of theoretical Free Trade, advertisement after advertisement of certain big coal dealers quoting identical prices of this commodity—prices which must be arranged by means as purely artificial as those that could be employed by any Trust in the world.

What have the Free Trade newspapers to say about this long-standing outrage upon their cherished principles? Nothing. It is difficult to see what the London County Council could do to help in breaking down the Coal Ring. But it is a piece of absurdity that the people of London, having given up putting an *octroi* duty upon their coal supply, should allow the big dealers to tax them beyond all reason for maintaining a useless army of canvassers, and returning profits which, when the retail trade is considerable, must be enormous. It would be waste of time and labour to beat about the bush in this matter. Colonel North has undertaken a good work for London; but he ought not to be left to fight the "ring" unaided, albeit if he breaks it single-handed his glory will be all the greater. The community has a right to ask that the noble and wealthy colliery proprietors who make such parade of public virtue whenever it suits their purpose, should put their hand to the same task of establishing a closer connection between the value of coal to the raiser and the price paid for it by the consumer. There is in every London morning newspaper a half-column in which the members of the Coal Ring blazon their mutual compact, and put their names to one of the grossest pieces of Protectionism permitted to exist in our days, which constitutes the gravest barrier to everything like sympathy between the colliery interest, whether of capital or labour, and the London public.

The Price of Gas in London.

THE history of a question asked on Thursday of the President of the Board of Trade by Mr. J. Rowlands is an illustration of the risk of misrepresentation run in these days by good-natured officers of public companies. Mr. Rowlands inquired of Mr. Mundella whether he had received a

scheme from the South Metropolitan Gas Company for cheapening the price of gas. To this the answer was in the negative. The questioner sought to pin the Minister to a declaration of policy in regard to the gas supply of London generally, in the event of the answer being in the affirmative. But, in the circumstances, the plan proved abortive; and the Minister rightly declined to say what he would do in a hypothetical event. The question was based upon a paragraph in one of the London daily newspapers, which stated not only that such a scheme had been propounded by the South Metropolitan Gas Company, but also went into definite particulars on the subject. It was asserted, among other things, that if the Company were allowed to reduce the illuminating power of their gas to 15 or 14 candles, they could then afford to sell it at 2s. per 1000 cubic feet; and references to the London County Council were lightly thrown in, with the object apparently of giving an aspect of verisimilitude to the paragraph. Of course, as an experienced eye would have judged at a glance, the whole thing was a *canard*. A few days ago some newspaper reporter called upon Mr. Frank Livesey, ostensibly to ask him a few questions respecting matters of common interest; and it afterwards turned out that the man had an ulterior purpose to serve, to which end he published a very inaccurate report of what the South Metropolitan Engineer said to him. This was the only foundation for the paragraph. It was not likely, on the face of it, that Mr. Livesey or any other responsible officer of a great Gas Company would "give "himself away" to a reporter of a halfpenny newspaper—or a penny one either, for that matter—by uttering statements calculated to entangle his employers in all kinds of complications without doing the slightest service to anybody. Yet, unfortunately, this is the danger run now-a-days by gas-works officials who, from the goodness of their heart, permit the poor penciller to make a bit of "copy" at their expense. It is true that what one interviewer states another can always be depended upon to contradict; but, meanwhile, a lie has been given a start of twenty-four hours or more, and then it can never be overtaken. The safest course to follow is never to admit to an interview any newspaper writer who asks for it. The probability is that he has a hidden object in seeking out his victim, which will not be disclosed until too late. It is an altogether different thing when the reporter is sent for. In the case of some newspapers, it is better to do this than to send a letter to the Editor. One thing at least is certain—the Press cannot safely be ignored by the respectable, stable portion of the community. Everybody reads the newspapers; and the demagogues and agitators would be only too glad to be left in undisturbed possession of them. It is not fair to the community at large that this should be; but a little of the wisdom of the serpent is necessary in dealing with pressmen, among whom there are just a few black sheep.

Manchester Gas Affairs.

In the number of the Journal for the 12th ult., we reproduced, as matter of current interest, the very remarkable "Memorandum" upon the actual condition of the Manchester City gas undertaking drafted by Mr. Southern, and by him circulated among his colleagues of the Corporation, with the object of raising afresh the simmering local question of the management of this magnificent, but sadly muddled property. The question is not a new one; and Mr. Southern is no novice in dealing with it. As a matter of fact, we have for many years known Mr. Southern in connection with the perennial controversy raised over the working of the Manchester gas undertaking. Unless we strangely err, he was returned to the City Council fifteen or sixteen years ago as an advocate of economy and efficiency in the management of the ratepayers' property; and he forthwith devoted his attention to the Gas Department, which, then as now, had no management at all worthy of the name. Naturally, at the onset, Mr. Southern was hardly expert enough in gas questions to deal effectively with the Town Hall party. But he has learned a good deal since then; and his latest effort is extremely creditable to a gentleman who has no pretensions to rank as a professional authority on gas-works administration. We refrained from commenting upon Mr. Southern's statement when it appeared, because it had no official weight, and had not been brought under the notice of the City Council. At the last meeting of this body, however, Mr. Southern's pamphlet was mentioned by the spokesman of the Gas Committee, who remarked upon the "charges" that had been brought by the author against the Committee, and declared, in the usual way, that the Committee were "prepared at the proper time to submit an answer" to these charges. This is the unfortunate habit of many public departments—whether they are national or municipal—when anybody ventures to make statements reflecting either directly or indirectly upon their policy and conduct. It is one of the curses of government by departments. The trick of it is learnt as quickly by a town councillor for a back ward in Manchester as by an Under-Secretary of State for the Navy. Every question is fenced with as covering a "charge;" and the result is that official explanations rank as no better than prevarications, and rarely satisfy anybody. Whatever the Manchester Gas Committee may pretend to think, in the supposed interest of the department, the Manchester gas undertaking is notoriously reckoned, by those who are competent to judge of such matters, as one of the worst, if not actually the worst administered property of the kind in the kingdom. Leeds and one or two other places run it close in this sense; but it is, after all, the largest as well as the worst example of how a gas undertaking ought not to be governed. Nobody interested in the gas industry would think of going to Manchester except to learn what to avoid; and the money that has been spent by deputations of the Gas Department in wandering about with a view of picking up "wrinkles" from smaller places, in order that they might not come to utter grief, is the subject of much local comment. We say nothing about the management of the different stations belonging to the Committee, which may or may not be satisfactory. But it is certain that the responsibility of every Station Manager ends at his boundary wall; and (fortunately for his professional reputation) there is no executive officer responsible for the management of the undertaking as a whole. Now and again the Committee discover themselves to be "in a hole;" and then they ask one of their Station Superintendents for a bit of assistance, or send a deputation to London, or anywhere else that they may imagine to hold the man whose aid they need at the particular juncture. They get their advice thus at hap-hazard; and generally neglect it. Indeed, a favourite Manchester Gas Committee performance is to obtain outside professional counsel, and then hatch something totally different by their own native wit. Then, when their proceedings miscarry, the great thing is to throw the blame on the adviser whose recommendations they did not carry out. And all this is done with such a wonderfully effective imitation of the style of the Circumlocution and Red-Tape Office, that every "charge" of a mere outsider is baffled, and the Manchester Town Hall, like its prototype in Whitehall, is triumphantly vindicated. It is to be hoped, however, that this time Mr. Southern will not be prevented from carrying his point. If he demands an impartial and independent investigation of the whole state of the Corporation gas undertaking, he ought to get it. For their own sakes, the members of the Gas Committee should court inquiry into all their methods and results; and the rest of the Corporation should be above consenting to a mere "whitewashing" investigation such as would doubtless please the department best.

Electric Lighting and Gas-Engines in 1893.

It was not without misgivings of a distinctly acute kind that we set ourselves last week to survey the course of electric lighting in the past year. Upon gas matters we feel safe and sound; but there is no harm in admitting that our treatment of the affairs of our friends the electricians is clearly that of a non-expert. It is therefore with a decided sense of relief that we find our chief electrical contemporaries have not much more to say for the history of electric lighting in 1893 than we were able to say for them in advance. They confess that many local authorities have been driven to take active measures in regard to carrying out the provisions of their Electric Lighting Orders, and that but for this movement there would not have been much doing in this line. They corroborate what we have had to say respecting the lack of definite progress in electrical systems and plant, and concede the point that no noteworthy cheapening of the supply from any plant actually in operation or in contemplation is to be expected. Electrical storeage is admitted to be a vain thing; and the idea of creating a "day load" is hopeless.

The advent of cheap incandescent lamps was of small moment; and, worst of all, there was no money (other than municipal) to be had for electrical schemes of any kind. Yet—and this is one reason why the subject is mentioned here—it is thought that an advance was made during the past year in the employment of gas-engines for generating electricity. This did not find a place in our retrospect of the gas industry for 1893, as it appeared to us to be a very small matter. But if it pleases our friends to recount it as a circumstance of the year, we have no objection to reciprocate. It is true that a great deal of business was done in gas-engines in the past twelve months, some of it in connection with electric lighting; but we are not at all disposed to concede that the gas-engine has specifically improved to any noteworthy extent. The comparatively recent expiry of the "Otto" master-patent put the whole trade upon a fresh footing; but no better engines were made in consequence. Those engine builders who abused the "Otto" cycle when they could not touch it have been glad enough to copy it since it became common property. This is not progress, although it may be multiplication. If the requirements of the electrician or any other order of power-users can educe a better kind of gas-engine than anything now upon the market, we shall be glad to welcome it. Meanwhile, it seems to be a feature of this branch of mechanical engineering that, although everybody knows what is wanted by way of improvement of the "Otto" cycle gas-engine, nobody can supply it. There are nevertheless more gas-engines at work than ever; and their price is being cut down more and more nearly to the steam-engine standard. For this the gas industry has much reason to rejoice.

The Gas Undertakings Returns.

EVERYTHING in connection with the extraordinarily prolonged parliamentary session—now, it is to be hoped, in its last days—seems to be correspondingly belated. Thus the annual returns relating to the authorized gas undertakings of the United Kingdom, which usually appear early in December, have only just been issued. Perhaps, however, the delay in the presentation of these papers is ascribable to the novel addition of an index to the undertakings included in the returns, which considerably facilitates reference to their contents. These valuable statistics are now in their eleventh year of publication; and all that need be remarked of them now is that, after making due allowance for omissions in the earliest returns, the last one shows a satisfactory growth of the British gas industry for the past decade. There are now 429 Companies' and 185 Local Authorities' gas undertakings in the list, representing a total authorized capital of £79,890,050 10s., of which £65,150,821 10s. is paid up and borrowed. The particularity of these figures is truly official; and one almost feels inclined to search the record in order to find out where that odd 10s. is in use. By the employment of this large capital, £18,676,333 was earned in the year, for an expenditure upon revenue account of £14,248,691. The weight of coal carbonized was 11,096,480 tons, yielding 111,481,278,000 cubic feet of gas, of which 102,834,552,000 cubic feet (in round numbers) were sold. The recorded length of gas-mains extended to 22,674¾ miles, serving 2,416,896 consumers and 489,505 public lamps. All these totals show a marked increase since 1882, some of them naturally more than others; the addition to the number of consumers being one of the most conspicuous and at the same time significant. The curious in comparative statistics will, as usual, find plenty to occupy their attention in these returns; and it is rather surprising that no paper on this very important subject has yet been submitted to any technical society.

The Late Mr. H. Gill, of Berlin.—With the view of marking the respect in which the late Mr. Henry Gill, M.Inst.C.E., the Chief Engineer of the Berlin Water-Works, was held by the authorities, and of testifying to the value of his services to the city, the Municipality are about to erect a bronze bust of him at the Muggelsee Water-Works.

Death of Mr. E. Shaw.—We regret to announce the death of Mr. Edwin Shaw, who for twenty years was a Director of the Glossop Gas Company. For the last five years, Mr. Shaw also occupied the position of Chairman of the Company; and for some time prior to that, he was Deputy-Chairman. He was a thoroughly practical man; and, by his removal, the Company lose the services of one whose place will not be easily filled.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 81.)

BUSINESS on the Stock Exchange reopened very quietly on the first working day of the new year; and at no time during the week was there any approach to activity. The tendency at first was fairly steady, after making allowance for the lack of support; but fluctuations subsequently set. The influential American Market was swayed first one way and then the other by rumours and counter-rumours; and the Foreign Market was dull and apprehensive. Elsewhere, however, a somewhat better feeling prevailed, and the closing prices were not the worst of the week. In the absence of anything like speculation, although people try to believe, and to make others believe, that the good time is really coming now, the better-class securities engross the lion's share of attention. The best of the gilt-edged stuff is now at such prohibitive prices that most investors have to be content with the second quality; and the large demand is running these up to first-class prices. The Money Market is in a very easy condition; rates are low, and are likely to remain so, for aught that is now discernible. The Gas Market was very quiet at first, but brightened up considerably later on; showing good general firmness, though quotations have not varied much. In Gaslights, the "A" advanced on the opening day, and, after some hesitation, made a further improvement, and closed on Saturday with business done at the top price. The secured issues were brisk, owing to the demand for investments. South Metropolitans were firm and unchanged. Commercials changed hands at about middle figures without alteration. The Suburban and Provincial Companies were as quiet as they have been for some time past; the few transactions marked being at good figures. The Continental division were fairly active, and European and Union realized nice prices; but Imperial showed no disposition to recover. Transactions throughout the rest of the list were few and unimportant; and the only change was a reduction in Bombay new. Very little business was done in the Water Companies; but all were strong, and several quotations have risen slightly.

The daily operations were: Business in Gas was not active upon the reopening of the Exchange on Tuesday; but prices were steady. The only change in quotation was a rise of 1 in Gaslight "A." Transactions in Gas on Wednesday were quite as restricted; and figures throughout were unchanged. In Water, Chelsea improved 2. Greater activity prevailed on Thursday in all descriptions of Gas issues, especially the debenture and preference stocks; but still quotations did not move, with the exception of a relapse of ¼ in Bombay new. In Water, East London rose 1; New River debenture, 1; and Kent, 2. Friday was rather quieter; but prices were good, especially for Continental Union and South Metropolitan "A." Quotations remained unchanged. Saturday was more than usually active, and the tendency was favourable almost all round. Gaslight "A" made a further improvement of 1.

ELECTRIC LIGHTING MEMORANDA.

The Edinburgh Electric Lighting Scheme—Present Electrical Distribution Systems to be Superseded—M. Tesla on a New Motor—Central Station Lighting in Cologne.

The latest central station electric lighting scheme to be submitted to the critical notice of the technical and general public is that of Professor Kennedy for Edinburgh. This is not the first project of the kind that the Edinburgh Corporation have had before them; for Professor Forbes had a notion of doing something very original for the city in the way of a combination steam and water power plant. This idea, it will be remembered, aimed at the solution of the problem of the irregular load, and involved the establishment of a pumping-station representing the average motive power required, which was to raise water to an elevated reservoir, whence it could be discharged through turbines at any desired rate. For reasons not difficult to understand, this ingenious suggestion never passed beyond the paper stage. Then Mr. Brown, a well-known local mechanical engineer, came forward with a proposal for lighting the city by means of gas-power stations, But, after all, the Corporation went to Professor Kennedy, whose credentials for the position are unexceptionable, and instructed him to report upon the subject and submit a practicable scheme. This has been done, and, as might be supposed, Professor Kennedy's plan has been received with sharp criticism by his friends and compeers of the profession. The scheme is claimed to represent the cheapest way of fulfilling the requirements of the Corporation. One generating station is to serve both the north and south sides of Edinburgh; but a mixed system of supply is recommended, involving a complete equipment of two distinct sets of machinery—a low-pressure continuous plant for the district adjacent to the station, and a high-pressure alternating current set for the distant distribution. It is this mixture of systems which is regarded by Professor Kennedy's critics as the weakest point of the scheme. It is contended that, while he was about it, he

would have done better to have stuck to the alternating system altogether; and the circumstance that he has been obliged to limit the field of application of the continuous current system is interpreted as an admission of its insufficiency. But is not Professor Kennedy a continuous-current man, by habit and practice in Westminster and elsewhere? The argument in the criticism above cited might be turned round the other way, and the fact that the Professor has been constrained to favour the alternating system for even part of the Edinburgh lighting interpreted as striking testimony in its favour by an electrical engineer whose predilections were originally all the other way.

While the partisans of the alternating and continuous current systems of electrical distribution are picking holes in each other's plans, Mr. Rankin Kennedy—not the author of the Edinburgh scheme—has been arguing in the *Electrical Review* against both systems, and in support of what he calls "two-phase currents." We are not sufficiently versed in the matter to judge of Mr. Kennedy's claims on their merits; and we are free to confess that we have read so much about these "phased" currents that we do not know the difference between the "boojum and the snark." However, it may probably be taken with safety that Mr. Kennedy's two-phase system is something different from either low-pressure continuous or high-pressure alternating currents; and it may be hoped that, when he gets a chance of putting it in operation, it may prove to be all his fancy paints it. If this should happen, it will be bad for those interested in other systems of electrical distribution, which Mr. Kennedy declares to be indulged in on too large a scale at the expense of the public. The idea is, he says, that they can in the future adopt improvements and get the benefits of new developments, to improve their system and reduce the present price per unit. In this, it is declared, "they are doomed to disappointment." How comforting to the investors in such systems! "At present there is nothing to complain of. But, sooner or later, when the gilt has worn off, the exact limitations of the systems now being adopted will become apparent;" and then all the electric lighting ventures will have to start fresh. With this prospect in view, the sooner the different undertakings get their depreciation funds into a healthy state, the better.

Mr. Nikola Tesla has by no means suspended his efforts to produce light by some more direct means than such as are at present available for the purpose. The greatest loss of efficiency in converting coal into light by the medium of electricity is in the steam-power plant. Accordingly, Mr. Tesla has been devoting his attention to this part of the problem; and he recently assured the New York Electrical Society that he hoped soon to be able to announce some gratifying results. He went so far as to express the belief that he will shortly be in a position to produce twice as much electricity from a given weight of coal as is at present obtainable. This he proposes to do by means of his "vibrator"—a mechanical and electrical arrangement about which he has already said something. In this device, both engine and dynamo are reduced to their simplest parts. The engine has no packing; hence it must be a kind of impetus machine, and the reciprocation takes place at an enormously high speed. Very high steam pressures can also be used, as there is no trouble with lubrication. In fact, Mr. Tesla is now having a boiler made for 350 lbs. steam pressure. The dynamo may consist of a simple coil caused by the vibrator to oscillate in a magnetic field. In fulness of time, we may hear more about this marvellous invention; and it is to be hoped that Mr. Tesla will show enough of the spirit of the true man of science to give the world the benefit of his failure, if this is to be his fate, as he is certain to do if he succeeds. There is a smack of Keely about this suggestion of a vibrating motor, which does not tend to inspire one with confidence; but it must be conceded that Tesla is a very different kind of man from Keely. All the same, it would not be surprising if Tesla should arrive at a demonstration that molecular vibration is a utilizable mode of motion. It is possible there may be more in vibration or resilience than has hitherto been obtained from it in a mechanical way.

An interesting report on the working of the municipal central station of Cologne has been translated and published in a recent number of the *Electrician*. The statement covers the third year of the existence of the undertaking, and shows that, although there was the large increase of 43·7 per cent. in the total number of lamps in circuit, the output of kilowatts did not increase in the same ratio. The reasons officially assigned for this are badness of trade and the introduction of the Welsbach gas-burner. As the Cologne electric lighting establishment is in the same hands as the gas-works, there is a refreshing candour about the report dealing with the experiences of the former in connection or in apparent rivalry with gas lighting. It is admitted that at current rates the cost of electric lighting in Cologne is nearly half as much again as that of gas lighting with flat-flame burners; and since the economical advantage of the incandescent gas-burner is fully appreciated by the scientifically-minded Germans, it is easy to perceive that the latter is officially expected to prove a serious bar to the further increase of the electric lighting business. Still, the electric lighting undertaking is doing fairly well. The capital outlay has been about £97,500; and the revenue account shows a profit balance of upwards of £7000, which was distributed as follows: £3237 to interest, £1850 to redemption, and the remaining £1980 to the fund for renewals. By far the larger proportion of customers are shopkeepers, after which come bankers and hotel-keepers. Only thirteen private houses in Cologne take the electric light; and the business people are just the class to whom the incandescent gas-burner appeals most strongly. Altogether, the Municipality may be reasonably well satisfied with the result of their public-spirited enterprise in providing the citizens of Cologne with good electric lighting at a moderate cost; but the business is scarcely one that a company would regard as prosperous or profitable. These accounts go to indicate that, in less than five years from the start, an electric lighting undertaking will arrive at all the trade it is possible for it to obtain.

NEW PREPAYMENT METERS AND GAS LIGHTERS.

STATEMENTS respecting the popularity of the "penny-in-the-slot" meter continue to appear from time to time in the newspapers; thus sufficiently testifying to the remarkable degree in which the idea of this method of facilitating gas supply to the humbler classes of householders has "caught on," not merely with the consumers themselves, but also with newspaper reporters and others who usually see nothing interesting in gas-fittings. This is a good thing in more ways than one; for although the field of utility of the particular appliance in question may be limited, the proof that it furnishes of the existence of previously unsuspected opportunities for the further development of gas supply must have a favourable influence upon the public mind. It becomes more difficult to keep up the affectation of treating the gas industry as being upon its "last legs," when the fact that a single piece of mechanism has been the means of unlocking an altogether new order of gas consumption has to be recognized. Notwithstanding its really hoary antiquity, the automatic machine for distributing commodities strikes the average newspaper writer and reader as being something particularly characteristic of this age of "progress;" and the circumstance that room has been found for an appliance of the kind in connection with gas supply, has no inconsiderable weight in bringing round people to see that the uses of gas are by no means of the past. Moreover, the adaptation of an automatic arrangement for controlling the passage of gas through a consumer's meter is of greater potency than any other device hitherto tried with a view to inspire confidence in this much-maligned measuring apparatus. The unreliability, dishonesty, and innate iniquitousness of the gas-meter have been the theme of the feeble newspaper witlings of two generations. We have grown tired of these jokes in this country, and the would-be jester who should try to palm off upon the editor of the weakest of so-called comic journals a piece of "copy" about a gas-meter, would probably share the proverbial fate of the minor poet who should hand in a composition on the subject of "Beautiful Snow." Ghastly jests—no pun intended—upon the unveracious meter still appear occasionally in Transatlantic newspapers, however; but the automatic meter will finally close this worked-out vein of humour. The fact that the consumer may himself control the registration of his gas will do more to help forward popular instruction in the mystery of index-reading than any mere printed direction or diagram, and will thoroughly and definitely eradicate the lingering superstitions that meter inspection is a farce and that gas companies charge their customers as much as fancy or imagination suggests.

It is to be expected that one effect of the popularity of the automatic prepayment meter will be an increase of Patent Office business in regard to consumers' gas-fittings in general. An astonishing amount of ingenuity and a great deal of money have been, and continue to be, expended in this way in regard to devices most of which may be safely classified as more or less clever suggestions for doing things that nobody wants done, and which would not pay for the doing even if the arrangement worked properly. We shall continue to hear a good deal of automatic prepayment meters of various patterns, because there has been shown to be a profitable field for this kind of gas apparatus. The history of gas lighting is full of instruction relating to attempts at the improvement of gas apparatus in other directions, which have come to nothing not merely because the so-called improvements were incapable of effecting their purpose, but because the purpose itself was a mistaken one. The atmospheric burner is a good example of this weakness of inventors. This is not by any means an ideal appliance, even in its best forms; but the ordinary improver of the usual apparatus does not know its real defects, and sets himself to remedy only those which are either imaginary or are more obvious than serious. A long chapter might easily be written, though it would scarcely be easy to read, upon the multiplicity of devices that have been patented for enabling the proportions of air and gas in atmospheric burners to be varied at the will of the user; for automatically reducing the flow of gas to the burner when cooking utensils are removed from above it; and for effecting other objects equally useless and even mischievous—often at considerable increase of the first cost of the apparatus. Very few inventors have grappled with the practical problems of making an atmospheric burner, as fixed in a cooking-stove, for example, uniformly efficient under all ordinary variations of pressure, incapable of giving off an offensive odour, silent, safe from risk of lighting-back, and strong enough to defy all but maliciously inflicted damage.

Then, a few years ago, many inventors attempted vainly to make street-lamps light and extinguish themselves automatically. It is not any exaggeration to say that scores, if not hundreds of patentees strove, with perseverance worthy of a better cause, to adapt the variation of pressure as between day and night to the service of lamp lighting and extinguishing. Pressure governors and electric sparks, with electro-magnets, cocks cased with glycerine—these elements were combined and re-combined in endless futile variety, with the object of doing what any gas manager could have explained to be undesirable. Some of these combinations were very ingenious, and, given favourable conditions, worked fairly well. What the patentees of such devices failed to understand, until they had one after another bought their knowledge at an exorbitant price, is that public-lighting arrangements to be operated by differences of gas pressure are only possible in districts where such differences can be depended upon to occur at the right time, and at no other. This consideration strikes out at a blow all large town areas, and restricts the usefulness of the device to such elementary gas-distributing systems as comprise only one main, where there is nothing to interfere with the transmission of the impulse of pressure from the source of supply to the last lamp-service; and even then the trouble of seeing that the automatic apparatus works, and the responsibility of keeping the lamps duly lighted, remain to discount the small advantage of any mechanical street-lamp lighter.

Yet there is still a distinct field of usefulness for reliable means of lighting and extinguishing gas-burners from a distance, which is much wider than anything offered by ordinary street-lamps. The pilot-light is employed much more freely than was formerly deemed desirable as a means of igniting the gas in powerful lanterns. But this simple device has its drawbacks. Pressure must still be left on for it, day and night, albeit in large installations in public buildings, &c., a small bye-pass to the main cock serves this purpose without involving much cost or risk of fire and explosion. Still, the consumption of a number of pilot-lights is not always a negligible quantity; and a man would not incur the reproach of being a fidget or a miser for objecting to this constant flame, the use of which is momentary at long intervals. There is, indeed, something irritating in the persistent pilot-light, just bright enough to make itself visible during the daytime, and representing at best a clumsy and costly way of overcoming a difficulty of mechanism or location. For many purposes, however, not even this device is available; and the torch or some electrical arrangement has to be brought into requisition. While on this subject, we may mention having recently inspected a well designed and constructed gas lighting and extinguishing apparatus invented by an Engineer of Stockholm, which appears capable of rendering good service in many situations where a hand-torch would be dangerous or otherwise unavailable. It belongs to the class of electrical spark igniters from fixed points adjacent to the burner; but the elegance of the arrangement consists in the adaptation of a simple electric bell-push (which may be placed anywhere) to the office of igniting and extinguishing the gas alternately. The whole thing is extremely compact; and if there is a grain of truth in the claim of the electricians that incandescent electric lighting is economical by reason of the ease with which the light may be turned on and off by merely touching a button placed conveniently near a doorway, &c., for the purpose, this saving should be completely realized by the users of this most ingenious device

To return to the subject of automatic prepayment meters, with which we started, we have pleasure in drawing attention to the new attachment of the kind invented by Mr. Henry Green, Engineer and Secretary of the Preston Gas Company, which was noticed in our "Register of Patents" on the 22nd of August last. There is much novelty in the principle upon which Mr. Green has worked in this case, and great ingenuity in the way in which he has secured his object. The idea is to enable the consumer to purchase gas in any desired and convenient quantity by prepayment; and to this intent he is permitted to adjust the regulating mechanism himself, without troubling the company in the matter. The company are saved all risk of bad debts, inasmuch as the money is actually paid over to them or their agents before the gas is taken. The cost of collection is reduced; and the consumer is entitled to be put upon even better terms than if he ran a quarterly account, instead of paying extra for the accommodation. Moreover, there is not the temptation of the store of coin in a receptacle attached to the meter, which is not always in a situation where one would preferably locate a savings-box. Briefly described, Mr. Green's arrangement is as follows: The meter has an attachment represented outside by a pair of additional dials bearing circles of letters, and moveable pointers. The interior mechanism of the meter is described in the patent specification already referred to. Suffice it to say here that it comprises a system of gearing, simple and strong enough in reality, whereby the definite quantity of gas—say, 500 or 1000 cubic feet or more—is enabled to pass the meter. While the gearing is in this position, the pointers on the dials stand at certain letters—for example, the pointer on the upper dial at B, and that on the lower dial at K. This combination of two letters is called the "key" to the prepayment attachment. At any time before the allotted quantity of gas has passed through the meter, or afterwards—ample notice being given, by a gradual restriction of the flow, of the coming extinction—the consumer can, by a further payment, obtain fresh directions for re-setting his meter. He gets a new "key," in short, for every payment he makes. He has no means of finding out what are the next two letters to which the pointers of the two dials must be put in order to enable the gas-way to be opened. Anyone acquainted with the rule of permutations and combinations will perceive at once that the number of possible changes is practically endless. The same pair of letters never recurs on the same meter, and not even the inventor himself could set a meter to pass an additional quantity of gas without the help of the suppliers of gas. It is Mr. Green's proposal that, where this system is adopted, sub-districts of convenient size should be mapped out, and arrangements made for the reception of money for gas—say, at the local post office. Here, when a meter was fixed, its corresponding printed sheet of "keys" would be filed, with the inspector's pen run through the acting combination, as a guide to the office keeper. When a consumer calls to pay for more gas, he is supplied, in return for his money, with a slip of paper, telling him what to do to his meter; and unless he obeys the instruction he cannot get his gas. Anbody who has sufficient intelligence to use a combination letter lock can do all that is required. Experience shows, however, that it is not as much the stupidity of the persons into whose hands appliances of this kind may come that has to be guarded against, as their mis-directed cleverness. A "penny-in-the-slot" machine for any purpose is a standing challenge to the ingenuity of the dishonest; whereas the cleverest of sharpers would soon grow tired of vainly spinning round Mr. Green's pointers in the attempt to hit upon the combination that sets the gas free to pass. Even then, of course, his triumph would be of brief duration; for the ordinary index remains, and is checked in the usual way at the end of the quarter, when, if thought desirable, an account can be rendered in due course, but receipted, with the quantity of gas still due to the consumer carried to his credit. It should be stated that every prepayment attachment is good for twenty successive instalments, when it can be removed and replaced by a new one in five minutes, and the old one made ready for going on upon another meter. The combinations differ with every piece. It is a noteworthy circumstance that the two gas managers who have identified themselves with the invention of prepayment meters—Mr. W. A. Valon in the South and Mr. Green in the North—have both taken the view that the strict "penny-in-the-slot" system does not satisfy the conditions of their case, and have accordingly adopted devices which appeal to other classes of consumers besides the very poor. This only shows that one system will not go everywhere; but still there is plenty of room for all.

THE GAS UNDERTAKINGS RETURNS.

THE returns relating to the gas undertakings of the United Kingdom—for the year ending Dec. 31, 1892, in the case of the Companies, and March 25, 1893, in that of the Local Authorities—were issued last Thursday, pursuant to an order of the House of Commons dated the 10th of November. Although this order was given much later than usual, the publication of the returns has been delayed by only about three weeks. We give below the principal figures.

The returns furnish particulars in regard to 429 authorized gas undertakings in the hands of Companies, as compared with 422 and 416 for the years 1891 and 1890. Two of the Companies are in Scotland, and nine in Ireland. Local Authorities to the number of 185 sent particulars as to their undertakings, as compared with 182 for the year 1891-92. Of these, 145 are situated in England and Wales, 34 in Scotland, and 6 in Ireland. The total amount of capital authorized for the 614 gas undertakings is £79,890,050 10s., of which £65,150,821 10s. has been paid up and borrowed. The previous amounts were £78,764,091 10s. and £63,620,461 10s. The revenue receipts are £18,676,333, compared with £18,395,687; and the expenditure is £14,248,691, against £14,307,451. With regard to the working statistics, the quantity of coal and cannel carbonized in the periods covered by the returns was 11,096,480 tons; the bulk of gas produced therefrom being 111,481,278,491 cubic feet, of which 102,834,551,961 cubic feet were sold. The previous totals were: Coals, 11,219,292 tons; gas made, 108,694,259,471 cubic feet; gas sold, 99,869,805,165 cubic feet. At the date of the last returns, there were 22,674¾ miles of mains in use for the supply of 2,416,896 consumers and 489,505 public lamps. The previous figures were: Miles of mains, 22,377; consumers, 2,353,037; public lamps, 475,084. The returns are in most cases made up to the dates above named; but where other periods have been taken, the fact is indicated. In a few instances, no information can be given as to the make of gas; while in other cases, estimates only are sent in this respect, as well as in regard to the consumption for public lighting and the length of mains. In the last-named particular, the companies fail in six instances. The amount of capital authorized for gas undertakings in the hands of both Companies and Local Authorities includes, in some instances, other purposes, such as water supply.

Comparing the foregoing figures with similar returns for the

previous years, it will be seen that the capital obligations of the Companies are as follows:—

Year.	Share and Premium Capital Paid up.	Loan Capital Issued.	Capital Sold under Auction Clauses.	Premiums Realized.
1883. . .	£29,038,726	£5,075,804	£2,538,709	£1,088,675
1884. . .	29,594,464	5,330,550	2,810,415	1,188,750
1885. . .	30,109,429	5,404,141	3,088,460	1,306,238
1886. . .	30,960,026	5,679,830	3,209,564	1,393,773
1887. . .	31,556,788	5,839,792	3,354,093	1,473,656
1888. . .	31,736,024	6,002,510	3,488,588	1,517,902
1889. . .	32,117,202	6,090,546	3,641,730	1,563,595
1890. . .	32,884,026	6,568,676	4,008,465	1,765,557
1891. . .	34,282,164½	6,862,117	4,300,266	1,823,068
1892. . .	35,266,898½	7,149,367	4,755,597	2,144,619

Some of the other comparative details in the Companies' returns are—

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1883. . .	5,171,963	52,330,749,963	1,091,388	235,338
1884. . .	5,361,576	54,452,255,864	1,102,628	242,782
1885. . .	5,595,371	56,903,050,785	1,115,223	250,404
1886. . .	5,777,966	59,051,111,814	1,133,897	258,072
1887. . .	5,977,254	61,266,055,857	1,152,119	264,316
1888. . .	6,050,588	62,328,542,470	1,103,198	259,921
1889. . .	6,309,495	64,627,914,489	1,128,838	268,013
1890. . .	6,618,460	67,214,546,500	1,153,989	275,611
1891. . .	7,071,161	70,953,927,023	1,180,333	282,761
1892. . .	7,119,189	72,178,028,396	1,213,322	288,021

The somewhat similar figures for the Local Authorities are—

Year.	Amount Borrowed, including Annuities (not deducting Repayments).	Receipts.	Expenditure (exclusive of Amount in the next Column).	Interest, &c., Paid.*	Net Profit after Payment of Items in preceding Column.
1883. .	£17,874,351	£4,252,296	£2,877,732	£873,921	£524,010
1884-5 .	18,758,895	4,334,059	3,066,386	894,836	399,714
1885-6 .	19,619,416	4,348,105	3,117,989	901,773	355,469
1886-7 .	19,723,046	4,403,262	3,127,047	951,636	359,532
1887 8 .	20,081,435	4,495,093	3,161,604	923,157	439,467
1888-9 .	21,333,833	4,817,269	3,375,197	977,154	479,489
1889-90 .	21,669,789	5,067,843	3,627,578	971,755	486,483
1890-91 .	21,891,655	5,628,212	4,231,643	956,183	460,608
1891-92 .	22,476,180	5,906,319	4,589,109	965,533	397,947
1892-93 .	22,734,556	5,983,359	4,702,179	994,517	305,040

* These figures include: (1) Interest paid on loans; (2) amount paid for annuities; (3) amount of loans repaid; (4) amount paid for redemption of annuities; (5) amount placed to sinking fund.

Year.	Tons of Coal Carbonized.	Cubic Feet of Gas Made.	Number of Consumers.	Public Lamps Lighted.
1883. . .	2,459,341	24,507,217,850	928,458	140,198
1884-5 . .	2,642,942	26,120,491,840	955,728	144,506
1885-6 . .	2,783,533	27,734,666,850	979,802	151,670
1886-7 . .	2,879,765	28,880,425,240	996,480	155,849
1887-8 . .	2,985,577	30,105,457,962	1,011,139	159,264
1888-9 . .	3,204,982	32,381,124,770	1,089,748	174,191
1889-90 . .	3,353,516	33,453,368,830	1,115,267	178,867
1890-91 . .	3,623,967	35,796,491,799	1,143,289	184,773
1891-92 . .	4,148,131	37,740,332,448	1,172,704	192,323
1892-93 . .	3 977,291	39,303,250,095	1,203,574	201,484

The returns are presented in the same form as in previous years, with the exception that those now under notice are each furnished with an index. As the towns are grouped in the returns under their respective counties, this useful addition facilitates reference to the particulars supplied.

SOME ASPECTS OF THE COMPETITION OF GAS WITH OTHER ILLUMINANTS.

Among the manifold applications of the teachings of physical science to promote the convenience or ameliorate the lot of mankind for which the present century is remarkable, the provision of greater facilities for artificial illumination holds a foremost place. It is difficult, if not altogether impossible, to realize the full extent of the change that has been effected in the nightly appearance of our streets and dwelling-houses during the eighty years that have elapsed since Ackermann, in 1812, lighted his premises in the Strand with gas, and thus first showed to the wondering citizens of London the practical application of Murdoch's discovery. Nor has the improvement consisted alone in the substitution of one lighting agent for another. While gas has to a very great extent taken the place of oil and candles, and is now itself being, in many instances, supplanted by electricity, it is important to notice that the consumption of the older illuminants has, after all, not suffered with the change, but, on the contrary, has very greatly benefited. And, further, increased competition has, in every case, had the effect of improving the useful duty obtainable from the illuminant, and reducing very considerably its cost. The last thirty years only have seen perhaps the most notable advance that has marked the history of both oil and candle light, in the commercial introduction of solid paraffin and of mineral oils while, within a very recent period, wonderful strides have been made in the perfecting of lamps, and in cheapening and improving the quality of burning oils. The appliances now generally available for obtaining light from oil give, it may safely be said, from 50 to 100 per cent. better results than those of a quarter of a century ago; while the cost of the oil itself is a mere fraction of what it was. It is not then surprising that oil is used for lighting to a much greater extent than before. Indeed, the combined result of improvement in lamp and illuminant has been to place oil in a very favourable position as an economical illuminant; so that while we need not fear that it can ever take the prominent place held by gas, it may yet wisely be held a formidable rival to the latter. Ignoring the drawbacks and disadvantages attendant upon lighting by oil, which are sufficiently obvious, let us consider in what its advantages consist.

Hitherto oil has necessarily been used by the poorer classes to the exclusion of gas because the former could be purchased in small quantities as required, whereas the use of gas implied a credit account, generally with some sort of security for payment; but this notable difference is in a fair way of being wiped out. Thanks to the invention of the prepayment meter in its various forms, gas is now able to compete with oil, on the same footing, in the houses of the poor.

A more distinctive difference between gas and oil, considered as rival illuminants, lies in the fact that the oil-lamp contains, complete within itself, its store of combustible, while the gas-burner must be permanently connected, through a continous line of communication, with a distant store or source of gas. Thus the oil-lamp is a portable luminant, and the gas-burner a fixed one; and while the former may therein secure a certain advantage, it must not be overlooked that the advantage, such as it is, is attended with equal and consequent drawbacks and danger. All the same, it is open to question whether the disadvantages sometimes attending the fixture of ordinary gas lights has been sufficiently realized, and whether more might not be done in the application of flexible tubing, or by other means to overcome them, and generally to provide sufficiently varied, convenient, and efficient appliances to meet all the different requirements of gas consumers. We are, of course, aware that there already exists an extensive choice in the variety and elegance of gas-fittings available for the favoured few with whom expense is no object; but it is rather the lower middle class, who form the great bulk of gas consumers, that we have in view. Notwithstanding the competition which now obtains in the manufacture of improved gas-burners and fittings, their cost is very considerable. A well-appointed oil-lamp, of the most recent construction, is much cheaper than (say) a good regenerative gas-burner of equally elegant design.

In this connection, it may be well to note that, while producers of lighting oils have done much to further the perfecting of suitable lamps for the consumption of oil, little has been done in a similar direction by those responsible for the provision of gas-light. Both the regenerative and the incandescent gas-burner, we owe to the initiative of outsiders; nor can it be said that gas companies have done much to further their introduction and foster their growth. Indeed, it must be confessed that they have, in the past, concerned themselves far too little about the application and use of the commodity which they were content to supply. But the experience of the last few years in the promotion of cooking and heating by gas has shown that consumers are ready enough to respond to the invitation to extend the uses of gas, when wise and skilful guidance is provided. And the same result may be expected in the further and higher development of its possibilities as an illuminant, with regard to which so little has, after all, been done.

Take, for example, the lighting of churches and factories—two fields which offer ample scope for the application of all the resources of gas lighting, but in regard to which, as ordinarily practised, there has been little or no advance made since the early days of gas lighting. Can it be doubted that, on the one hand, it is possible to effect a great improvement, as regards convenience, efficiency, and economy in the lighting of such interiors; and, on the other hand, that the way to obtain such a boon only requires to be clearly shown in order to be largely followed? In nine cases out of ten, a church is illuminated by a number of naked gas-jets arranged singly or in clusters, and disposed about the building in exact correspondence with the candles which they originally displaced. The burners employed are necessarily of the class which develop but a fraction of the total luminosity obtainable from the gas; while the bare flames, interposed in the line of vision, produce a painfully dazzling effect on the eyes. By the application of more perfect appliances, a much higher duty might be obtained from the gas consumed, which would allow of the flame being concealed from direct sight by screens contrived to direct the rays of light where required while moderating their intensity. Thus economy and efficiency would be simultaneously secured.

We are prepared for the obvious retort, "The first cost of such appliances is at present too great, and their maintenance in perfect order too troublesome and expensive to be extensively adopted by any but the wealthy, or those who can use them for business purposes." But the same might have been said of gas cooking and heating apparatus in their infancy.

When it is clearly recognized, by the proprietors of gas undertakings, how intimately is the continued prosperity of their industry bound up with the fuller development of the capabilities of gas, such objections will be overcome. We have so recently had occasion to refer to the defective lighting of factories and workshops, as commonly carried out, and to advocate the devotion of more and more intelligent attention to the subject,* that it need not be further dwelt upon here.

Turning now to the competition which gas has to face from its latest rival, electricity, we notice a remarkable feature which distinguishes the electric light from other illuminants—it is fashionable. Whether there ever was a time when gaslight was similarly favoured, we know not; but it has certainly not been in our day. It may be due to the mystery attending the occult nature of the force itself, or to the marvellous achievements which this generation has witnessed in the various applications of electricity; but, whatever the cause, the fact remains that the favour of the public is unhesitatingly given to anything which is called electric. This must be admitted and reckoned with, after all has been said that can be in favour of electric lighting. It is also to be noted that the popularity of the new illuminant has led to a more general employment of superabundant artificial light as a means of advertisement for trade purposes. Whereas formerly the standard of illumination in shops and warehouses was the minimum quantity necessary to allow of the transaction of business with sufficient despatch, it is now recognized that the brighter and more attractive such establishments are made, the more prosperous they are likely to be. In a certain sense, it may be said that supply has created demand; the provision of enlarged facilities for artificial illumination having led to the adoption of a higher general standard of lighting, both of interiors and open spaces, and thus brought about an increased consumption of the different lighting agents. To this extent gas has benefited by the advent of the electric light. But more than this. Just as the most notable advances in oil lighting have been made under the spur of necessity, to prevent being left utterly behind in the race for public favour, so it has needed the stimulus of competition, with electricity on the one hand and oil on the other, to bring about the development of the most effective appliances for burning gas. And while there is no fear in our mind as to the result upon gas interests of the contest with the newer rival in the field of lighting, it is well to scrutinize forces, noting the weak places on our side, and, if necessary, adopting the tactics of our opponents in order to strengthen our position.

It is daily being shown that certain classes of users of artificial light are prepared to spend lavishly to obtain an adequate return in effective lighting; and it should be the endeavour of suppliers of gas light, not merely to *meet* their demands, but to *attract* them. It must be admitted that the promoters of electric lighting have shown remarkable enterprise, and been unsparing in the expenditure of means to show forth, on an extensive scale, the resources of the new illuminant. It had been well if gas had earlier taken the same course of exhibiting and bringing to the notice of the public the capabilities of gas lighting. Unfortunately, the generally uninterrupted commercial success of gas undertakings, and the peculiarities of their position, conduced to a *laissez faire* policy, from which some of them are hardly yet thoroughly aroused. This lamentable defect, on the one hand, and the public infatuation for things electric, on the other, have resulted in gas not only being simply supplanted by electricity, but so, in many instances, under circumstances reflecting unmerited reproach on the older illuminant.

We have in mind a modern instance illustrating very pointedly our meaning. One of our large commercial cities has, in order not to lag behind in the march of so-called progress, recently embarked on a municipal electric lighting scheme upon a somewhat extended scale. It enjoys already the distinction of leading the way in the most admired modern methods of municipal administration of gas undertakings. It supplies a gas of fairly high illuminating power, judged from the southern standpoint; and, if allowance be made for the respectable contribution to street improvements expected from the consumer, it sells gas at a reasonable figure. Now the city boasts, and with pardonable pride, a noble Library and Reading-Room, likewise the property of the ratepayers. Hitherto this building has been lighted, as three-fourths, or we might even say a greater proportion, of our large public buildings are lighted, by means of naked gas lights furnished by almost the commonest and cheapest burners obtainable—burners developing, from the gas consumed, a duty of not more than 50 or 60 per cent. of the light yielded with the standard burner, and consequently inferior, in a much greater degree, to the latest developments in gas-lighting apparatus. In this crude manner the building was, in general, fairly well lighted, but not at all brilliantly; some of the smaller rooms being both insufficiently lighted and ill-ventilated. Here, as it were within the gates of the proprietors of the gas undertaking, was a splendid opportunity for promoting at once economy and efficiency in service, increasing the comfort of the frequenters of the library, and showing forth on a truly magnificent scale all the resources and possibilities of gas lighting. But the City Fathers never took advantage of it. What had done, in the way of gas lighting, for one generation would do very well for another, seems to have been the accepted plea. Regenerative burners, incandescent burners, and ventilating burners might not have been invented, for any use which was made of them here, where their advantages would not only have been of the greatest direct benefit, but would also have furnished an object-lesson in the applications of gas to lighting and ventilation, and been a magnificent advertisement of the illuminant itself. As soon, however, as the electric light begins to loom on the distant horizon, it is discovered that improved illumination is imperatively required, and can only be satisfactorily provided by the newer and more "advanced" illuminant. Cost is not taken into consideration. If the mere thought of it cropped up in the mind of some antiquated adherent to old-fashioned economics, it was ruthlessly brushed aside by the desire to "advance with the age," or was crushed beneath the weighty opinion of some distinguished scientist, who affirms that light was produced by electricity at much less cost than by gas.

Now the change has been accomplished, what do we see? Brilliantly, not to say extravagantly, lighted rooms, it must be frankly confessed. Nor could any other result be looked for, when we consider the superabundance of the means employed. The principal reading-room—a noble apartment, spacious and lofty—is lighted by ten arc lamps, where formerly were five gaseliers of thirty small jets each. The entrance hall contains two electroliers, each consisting of four incandescent lamps, where before was one gaselier of three jets. In other rooms, each small gas-jet has been superseded by two incandescent lamps of, we suspect, nominally higher illuminating power. And not only so, but these latter are better distributed over the area to be lighted. Thus, compared with the gas-burners which performed the duty before, the provision of electric lamps to light the building has been on an exceedingly liberal scale; and it is therefore not a matter of surprise that the result should be regarded as eminently satisfactory from the point of view of the frequenters of the library. It ought, however, to be, in fairness, remarked that formerly there were no rude winkings of the gas lights to distract the attention of the student from his book, as occasionally disfigure the arc lights which have now supplanted them. But this is a weakness inseparably bound up with the younger illuminant, and is patiently borne with, in the hope that it will, in time, be grown out of; although, as yet, after many years, there is no sign of "a consummation so devoutly to be wished" by electricians. Without cavil, however, we grant that the building is, on the whole, much better lighted than before. Even the gas manager must admit that the general result is a great triumph for electricity—a triumph rather overwhelming than respectable or complete, considering the disproportion of the powers employed.

But what about the cost? "Ay, there's the rub!" We are not, of course, yet in a position to form even an approximate estimate; but we shall be very much surprised if the expense of lighting by electricity, on the present liberal scale, does not amount to, at least, four or five times the former cost for gas. We should, however, be only too glad to have our estimate confirmed or set right by definite statements of the actual comparative cost of lighting by gas and by electricity in such examples as the one above indicated. And now that there are so many instances of municipalities supplying both gas and electricity, there should be somebody in authority, some member of a Gas and Electric Lighting Committee or some superior official, who is sufficiently interested in the subject to work out the problem here presented, and both able and willing to make known the results of his investigation for the information and guidance of our readers and the gas profession generally.

In conclusion, we would urge upon all who are responsible for the continued welfare of the gas industry the lesson which is taught by the facts we have reviewed, and the thoughts we have had under consideration—namely, that more attention must be paid in the future to the appliances generally available for the consumption of gas, and that the capabilities of gas lighting must be forced upon the attention of the public. The gas consumer must be aided and guided to develop the best results possible from the illuminant; and who more likely than gas suppliers to be to the front in showing how this may be done?

The Engineership of the Nottingham Corporation Water Department.—At yesterday's meeting of the Nottingham Town Council the Water Committee reported that they had appointed, out of 73 candidates for the position of Engineer of the department, Mr. Donald M. F. Gaskin, M.Inst.C.E., at a salary of £600 a year. Mr. Gaskin has been for the past seventeen years Engineer of the St. Helens Corporation water undertaking.

Extension of the Profit-Sharing System of the South Metropolitan Gas Company.—In the course of an interview with the representative of a London evening paper last week, Mr. George Livesey stated that the South Metropolitan Gas Company had decided to extend the bonus system, so that the workmen might ultimately become shareholders in the undertaking. He explained that the bonus is to be increased by 50 per cent., on condition that one-half of the whole amount is invested in the Company's stock. The money will be placed in the hands of trustees; and when a man has invested sufficient to buy £5 worth of stock, a share will be issued in his name. In the event of a man leaving the Company's service, or dying, the money will be withdrawable at a week's notice.

* See Vol. LXII., p. 797.

NOTES.

Concreting Quicksand.

Various devices have been suggested for dealing with quicksand in excavations, such as freezing the water by circulating a freezing mixture through tube-wells sunk into the unstable stratum. Another proposal is made by Mr. F. Neukirch, of Bremen, which is to convert the quicksand into solid concrete *in situ* by blowing into it dry cement under air pressure. The method of operation is an extension of the well-known hydraulic or pneumatic system of sinking piles or anchors in sand. A pipe 1½ inches in diameter is used, with its lower end drawn out to a point, and provided with three or more ⅜-inch holes. At its upper end, this pipe is connected by a rubber tube to an injector, which is fed with the dry cement and compressed air. The sinking of the pipe in the ground is facilitated by blowing air through it; and in this way a depth of 16 to 19 feet can be easily and quickly reached in fairly loose soil. When the stratum of quicksand is met with, the cement is blown in, and the air carries it to some distance through the sand, and ensures a thorough mixture. The pipe is then slowly withdrawn—the supply of cement being continued until it reaches the surface. The whole area to be treated is mapped out into a number of sections of about one square foot; and the tube is sunk in all of them in rotation. It is necessary to begin this preparatory work some months before the excavation is to be made, because the underground concrete takes several weeks to harden, and is a long time coming to its full strength. The process has been successfully used in connection with sewer work in a narrow street in Bremen, where the sand came away with pumping; and it was feared that the neighbouring buildings would be undermined. The site of a gasholder tank where quicksand is met with might conceivably be isolated in this way by surrounding it with a ring of underground concrete

Coke Concrete Fireproof Floors.

It has been stated by Mr. W. Sabin, of Cleveland, that a kind of coke concrete is now being largely used in America in a cheap and light system of fireproof construction. In this system, floors are divided into spans of 12 feet square at most, by rolled beams of I section, and 12 inches deep. Between these beams is stretched stout galvanized wire netting; and the whole space is then filled up with the concrete, which is composed of coke, cork, cement, and a little sand. A floor of this construction, which appears to be very like the well-known Monier system, can be made with safety as thin as 8 inches in depth, when its weight is only 18 lbs. per square foot; and it will bear a load of 580 lbs. per square foot with a small deflection. It has been remarked, however, that a floor of coke concrete can only be classified as fireproof so long as it is carefully protected from actual contact with fire in flues or furnaces. For the ordinary purposes of a floor or wall, it is practically fireproof in the sense that it will not ignite by contact with a flame; but the combustibility of coke is not destroyed in any way by the coating of cement it receives when made into concrete.

The Power Expended in Riveting.

The power required for closing rivets is a somewhat curious point in mechanics; for the same work that is done by percussion by the hammers of a pair of hand riveters can only be performed by a squeeze of many tons in the case of hydraulic riveting. The relation between the two applications of power to this purpose has never been made out; but the subject was recently discussed by the Engineers' Club of Philadelphia, on the initiative of Mr. Henrick V. Loss, who exhibited a number of diagrams taken from a hydraulic riveter by using a common steam indicator in connection with a pressure-reducing cylinder. These showed great variation in pressure in relation to rivets of the same size, amounting to 50 per cent. for ¾-inch, and 25 per cent. for ⅞ inch rivets. According to the average, a pressure of 65 tons is necessary to close either a ¾-inch or a ⅞-inch rivet. The circumstance of both sizes of rivet requiring the same pressure is explained by the fact that the smaller rivet cools quicker. With regard to the energy consumed, Mr. Loss calculates that a ¾-inch rivet needs about 7200 foot-pounds, while a ⅞-inch rivet requires about 9500 foot-pounds to form a head and fill the hole, if the work is about in proportion to the squares of the diameters. Mr. James Christie remarked upon this communication that he had observed the pressure required to upset small rivets to be very much larger per unit of area, and sometimes absolutely greater than for large rivets. Mr. S. M. Vauclain stated that a rivet to make a close joint by machine should be hotter under the head than at the point, so that if the rivet is equally heated the end should be cooled by dipping it in water immediately before inserting it in the hole. Reference was also made to the desirability of riveting-machines which could be used first for closing the work and then for squeezing the rivet.

Oil Fuel at the Chicago Exhibition.

An interesting report on the results of using oil fuel at the Chicago Exhibition has been presented to the Standard Oil Company by Mr. Charles F. Foster. This statement avers that the use of oil as fuel has been entirely satisfactory in every particular. During the period the Exhibition remained open, the main boiler plant consumed 10,614,401 gallons, or 74,300,805 lbs. of oil for generating steam; developing the aggregate energy of 32,315,964 horse-power-hours, at a cost of 6·3 mils per horse-power-hour. The contract price for the oil delivered in the Exhibition tanks was 72½c. per barrel of 42 United States standard gallons. The boiler-house force and equipment comprised 210 burners, atomizing oil beneath 52 boilers with a standard rating of about 21,000-horse power, and attended by a staff of 42 men divided into three eight-hour shifts. The saving in cost of both fuel and labour for the oil fuel, as compared with coal of fair quality at market price for large quantities, is apparent. An equivalent consumption of from 500 to 600 tons of coal per day would have been necessary, so that for the duration of the Exhibition 70,000 tons of coal would have been needed; and Mr. Foster remarks that "it would be difficult to imagine how this vast amount of coal would, in the limited space available, have been handled expeditiously and without endangering life and property." The saving to the Exhibition by the use of oil fuel was about 27 per cent. as compared with the estimated cost of coal, including the labour of handling. The oil plant worked from start to finish without a break; and the smokelessness and absence of odour from the chimneys of the boiler-house were made a subject of general comment. It is to be remarked, however, that this report does not say much for the prospects of oil fuel in a general way, for the gigantic experiment in question was only commercially successful to the degree stated, in comparison with coal, when the oil costs no more than 1d. per English gallon.

Patents in 1893.—It is stated that the number of patents applied for for the United Kingdom last year was far in excess of any previous twelvemonth's record—being 25,102, as compared with 24,166 in 1892. There has been a progressive increase in the applications every year since 1885, when the number was 16,011. This is the natural consequence of the reduction in the fees; but last year a special impetus was given to invention by the demand for improvements and novelties in connection with electric lighting and cycling.

New Scholarships for the Mason College, Birmingham.—Mr. Aubrey Bowen, of Melbourne, has bequeathed to the Trustees of the Mason College, Birmingham, the sum of £600 per annum, with the stipulation that it shall be applied in founding six scholarships, of £100 a year each, in connection with the College. They are to be called respectively the first, second, and third Bowen scholarships, for the promotion of the study of metallurgy, and civil, mechanical, and electrical engineering; and the remainder Priestley scholarships, for the promotion of the study of chemistry.

The Secretaryship of the Lambeth Water Company.—The successor to the late Mr. S. H. Louttit in the secretaryship of the Lambeth Water Company—Mr. Harry Wilkins—has now entered upon his duties. Prior to his appointment, Mr. Wilkins was not in any way connected with the Company; but he was specially qualified to fill his present position from his intimate acquaintance with the subject of the Metropolitan Water Supply. He was formerly Vestry Clerk of St. James's, Westminster; and, as our readers may remember, he was called upon to devote considerable attention to this question about three years ago in connection with the movement of the associated Vestries and Local Boards of the Metropolis for an alteration in the water legislation. Mr. Wilkins is a barrister-at-law by profession.

The Price of Gas in the Metropolis.—In the House of Commons last Thursday, Mr. J. Rowlands asked the President of the Board of Trade whether he had received a scheme from the South Metropolitan Gas Company "for the cheapening of the price of gas;" and, if so, whether, before arriving at a decision upon it, he would, in answer to the petitions presented to the House from the St. Luke's and Chelsea Vestries, grant an inquiry into the present management of the various Gas Companies of the Metropolis, their statutory rights, and the working of the sliding-scale of price and dividend. Mr. Mundella replied that he had not received any such scheme; and until it was before him, he could not say what action it would be his duty to take in reference to it. Upon being further questioned by Mr. Rowlands as to whether he had anything to say in regard to the two petitions alluded to, Mr. Mundella said he had not seen them.

Outdoor Illumination by Auer Incandescent Gas-Lights at Budapesth.—According to a paragraph in a recent number of the *Journal für Gasbeleuchtung*, a trial has been going on since June last in the Badgasse, Budapesth, and since October in the Ofen Tunnel, with Dr. Auer's incandescent gas-lights. So satisfactory is the effect, that when the Budget estimates come on for discussion, it is intended to put forward a request that all streets in which the electric light is not to be used shall be lighted by the incandescent gas system, as by it the amount of illumination afforded is increased by five or even six fold. In Agram also Dr. Auer's burners have been tried with equally favourable results. While under the old system each 630 square metres of street surface received light equal to only 32 candles, every 300 square metres of surface is now illuminated to the extent of 100 candles. The lighting, therefore, is more than six times as great as that ordinarily employed for streets.

TECHNICAL RECORD.

FLAME.

An Evening Discourse to the British Association at Nottingham, by Professor A. Smithells, Sept. 15, 1893.*

The subject on which I have the honour to address you this evening is, I am aware, one of the most hackneyed among the topics that have served for popular scientific lectures. I can only hope that it has not quite lost its charm. The chemist is often twitted with having to deal with mere dead, soulless things, which at the best only set themselves into angular and unpalpitating crystals. There may be a certain amount of truth in this; but in flames we surely have phenomena of some liveliness. Our flame must be fed; it has its anatomy and varied symmetry; it is vigorous, mobile, and fleeting. I do not wish to make extravagant claims, but I do think that one may be excused for feeling almost as much interest in the study of flame as, for example, in the contemplation of the somewhat torpid evolutions of an amœba or the circulation of water in a sponge. To our guileless ancestors, at any rate, flame was a phenomenon of the rarest mystery. Unable as they were to discriminate between the material and the immaterial, unable to track the solid or liquid fuel to its gaseous end, this radiant nothingness called "flame" became to them one of the primary inscrutable, irresolvable things of Nature—an all-devouring element, often of peculiarly divine significance.

The essential nature of flame appears to have been discovered at the beginning of the seventeenth century by the Belgian, Van Helmont. This remarkable man is well known to chemists as one of the acutest and least superstitious of the whole band of alchemists. He was somewhat speculative in the domain of physiology; but in chemistry he made discoveries of fundamental importance. From our immediate point of view, one of the most important things he did was to sweep away the mystery that had so long attached to the gaseous state of matter. In so far as he distinguished between different gases obtained from different sources, he may be said to have been the first to bring aëriform matter within the range of substantial things that might be submitted to experimental investigation. It was in consequence of this that he was led to the discovery of the nature of flame. I will quote the important passage from his writings:

> But the flame itself, which is nothing but a kindled smoke, being enclosed in a glass, in the very instant perisheth into nothing. The flame indeed is the kindled and enlightened smoke of a fat exhalation. Be it so. But as the flame is such, and true fire, it is not another matter—being kindled and not yet kindled—neither doth it differ from itself; but that light, being united in its centre, hath come upon a fat exhalation which is the same as to be inflamed. Let two candles be placed which have first burned awhile—one, indeed, being lower than the other by a span, but let the other be of a little crooked situation. Then let the flame of the lower candle be blown out, whose smoke, as soon as it shall touch the flame of the upper candle, behold the ascending smoke is enlightened, is burnt up into a smoky or sooty gas, and the flame descendeth by the smoke even unto the smoking candle. Surely there is there the producing of a new being—to wit, of fire, of a flame, or of a connexed light; yet there is not a procreation of some new matter or substance. For the fire is a positive artificial death but not a privative one; being more than an accident and less than a substance.

We can best understand the meaning of this somewhat oracular statement by repeating Van Helmont's experiment. We take a bundle of lighted tapers so as to get a large flame; we hold over "in a little crooked situation" another lighted taper, and now blow out the lower flame. We note the ascending column of smoke, and observe that when it touches the upper flame it ignites, and the flame descends several inches through the smoke to the bundle of tapers. Flame, therefore, says Van Helmont, is burning smoke; it is not a new substance nor a mere chance occurrence, but the incandescence of a vapour or smoke that already existed.

Van Helmont only recognized in a vague way the important part played by the atmosphere in the phenomenon. This was realized much more perfectly soon afterwards by Hooke, who speaks of "that transient shining body which we can call flame" as "nothing but a mixture of air and volatile sulphurous parts of dissoluble or combustible bodies which are acting upon each other whilst they ascend"—an action so violent, he says, "that it imparts such a motion of pulse to the diaphanous parts of the air" as was requisite to produce light.

Without entering further into early historical details, I may say that it was only towards the end of the last century that the essential chemistry of the phenomenon was fully expounded by the great Lavoisier. He showed that, as Hooke had surmised, flame is the region in which combination attended by the evolution of light takes place between the components of a gaseous substance and the oxygen of the air.

The next step in the history of our knowledge of flame brings us to the memorable researches of Humphry Davy, whose name more than that of any other name is associated with this subject. Of Davy's work, I shall have more to say presently; but at this moment I will only make one allusion to it—an allusion which will provide us with a proper starting-point this evening. It is interesting to note that Davy's discoveries concerning flame were the consequence and not the cause of the discovery of the miner's safety-lamp. In this case, practical application preceded purely scientific discovery.

I need not describe the safety-lamp to you in Nottingham, where it has recently received such important improvements at the hands of Professor Clowes. When the lamp is placed in an explosive mixture, you know what happens—the explosive mixture burns with a quiet flame within the lamp, but the flame cannot pass through the wire gauze to ignite the mixture outside the lamp. I can demonstrate this by means of this large gas-burner, which is primarily a Bunsen burner—that is, a burner which, by means of holes at the base of the tube, draws in sufficient air to enable the gas to burn with a practically non-luminous flame. If I turn on the gas and apply a light to the top of the burner, I get a flash and a small explosion within the tube, but no continuous flame. The fact is that the mixture of gas and air within the tube is highly explosive. Placing a gauze cap over the burner and applying a light, I now get a steady flame. The explosive mixture made in the tube passes through the gauze and is inflamed, or, if you like, exploded; but the explosion cannot pass through the gauze, because the metallic wires withdraw the heat so rapidly that the mixture below it never reaches the temperature of ignition. Above the gauze, we have the continuous flame.

"These results are best explained," says Davy, "by considering the nature of the flame of combustible bodies, which in all cases must be considered as the combination of an explosive mixture of inflammable gas or vapour and air; for it cannot be regarded as a mere combustion at the surface of contact of the inflammable matter." Davy, then, regarded flame as being essentially the same as explosion; it was, in fact, a kind of tethered explosion.

Since Davy's time we have learned much about the nature of gaseous explosions; and we now know that such explosions, when fully developed, proceed with enormous rapidity, and are of great violence, incapable of arrest by such simple means as we have just used. Still there is not much to correct in what I have said. I think I cannot do better than show you the transition of flame into explosion by an experiment which was first shown by Professor Dixon in the lecture he gave at the meeting of the British Association in Manchester in 1887.

The apparatus I have here consists simply of a Bunsen burner surmounted by a long glass tube. If I turn on the gas and light it, I obtain at the top of the glass tube a steady flame. The mixture ascending the tube can scarcely be called explosive at present; but if I alter the proportions of gas and air suitably, it becomes distinctly explosive. Observe what happens when this is the case. The flame can no longer keep at the top of the glass tube; it passes within it, and descends with uniform velocity till at a certain point it flickers and then shoots down almost instantaneously to the bottom. This sequence of events is exhibited in all cases when flame develops into explosion. We are concerned only with the first phase—viz., that of comparatively slow inflammation; and a flame, we may say, is a gaseous explosion brought to anchor in the period of incubation.

There is one other point connected with explosion that we must note, on account of its important bearing on the chemistry of flame. When we are dealing with explosive mixture of gas and air, we find practically that the composition of the mixture may vary considerably and still retain its explosive properties. There is, of course, a certain mixture which presents the greatest explosive power; a further quantity of the combustible gas or of the air will diminish the explosibility, but not entirely destroy it till a large excess is used. With hydrogen, for example, two-and-a-half times the volume of air (which contains exactly the oxygen requisite to combine with the hydrogen and produce water) is the right quantity for the maximum explosive effect; but we will still get explosion when we have much more than two-and-a-half times as much air as hydrogen, or when, on the other hand, we have much less. In one case there will be oxygen left uncombined; in the other case, hydrogen. I dwell upon this in order that we may be prepared to find the same thing in flames, that we may not be surprised to find combustion taking place in mixtures where either gas or air is in excess of the quantity actually required for the purpose of chemical combination. Bearing this in mind, let us revert to the experiment I have just shown. It consists in mixing air with gas before burning it, to such an extent that the flame strikes down the tube. On close examination, we find this is not quite a correct statement; for when I regulate the air with nicety, it is only part of the flame that strikes down the tube. There remains all the while at the top of the tube another part of the flame which is not mobile. With a little care, I can adjust the proportion of air and gas so that the part of the flame which is mobile shall move up and down the tube like a piston. All the while the pale steady flame burns at the top of the tube. When in this critical condition, a little more air determines the descent of the moveable part of the flame; a little less sends it to the top.

Let us now turn to the explanation of this phenomenon. It is clear, in the first place, that coal gas and air form an explosive mixture long before there is enough air to burn all the gas. For it is only part of the flame that descends the tube, and there is enough gas passing through this part to form a second flame as soon as it reaches the outside air at the top of the tube. There

* An abstract of this lecture was published in the JOURNAL for Sept. 26 last (p. 582). The full text now given is reproduced, with the illustrations, from a recent number of *Nature*.

is, as a matter of fact, only about two-thirds as much air entering the tube at the bottom as would be necessary to burn the whole quantity of gas. We see, in the next place, that the explosibility varies greatly according to the proportions of gas and air. For what is the cause of the descending flame? It is simply that we have an explosive mixture in process of inflammation. The inflammation is tending downwards; opposed to it is the movement of the explosive mixture upwards. If the upward movement of the unburned mixture is more rapid than the downward tendency of the inflammation, the flame cannot descend. We can only make it descend by making the downward tendency greater. This we do by adding more air, and making the mixture more explosive. We can balance these two opposite velocities with the greatest nicety by a careful adjustment of the proportions of the explosive mixture.

In order to ascertain what proportion of gas is being burnt in this moveable flame, and what is the chemical character of the products there formed, it is necessary to keep the two parts of the flame separate, and to take out some of the gases from the intervening space. This can be very easily done. The flame descends, we have seen, because its rate of inflammation is greater than the rate of ascent of the combustible mixture. If now we can make this rate of ascent more rapid at one part of the tube than it is anywhere else, we may expect to stop the descent of the flame at that point, and keep it there. We can do this simply by choking the passage; for just as a river must flow rapidly where its banks are close, so must the stream of gas rush more rapidly where the tube is choked than either below or above, where there is a wide passage. If, then, I replace the plain glass tube by one that has a constriction in one part, and if I cause the inner cone of the flame to descend as before, it stops at the constriction, and will remain there any length of time. Its rate of descent is greater than the rate of ascent of the gas where the tube is wide, but not so great as that where it is narrowed by the constriction. We have now the two cones of flame widely separated. In this state of things we can, if we choose, draw off the gases from the space between the two cones by putting in a bent glass tube and aspirating. We could then analyze these gases, and see what has happened in the first cone. (See fig. 1, A.)

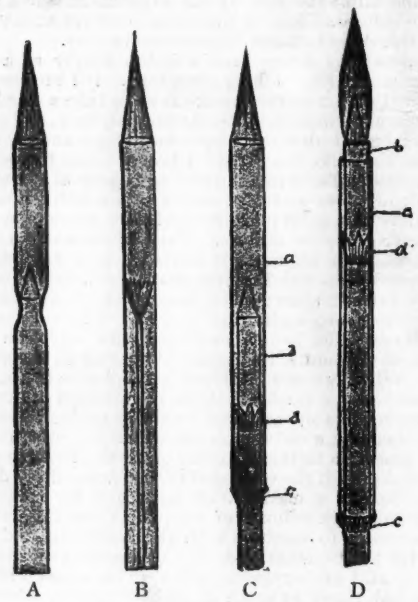


FIG. 1.—Methods of Separating the Two Cones of an Air Coal-Gas Flame.

I will now show you another method in which the two cones can be separated. It is based on the same principles as the one just used. I have here a two-coned flame burning at the top of a glass tube. I shall let the air supply be liberal, but not quite sufficient to cause the descent of the inner cone. The rate of ascent of the gas is now just a trifle greater than the rate of descent of the flame. If I retard the rate of ascent of the gas, the balance will be disturbed, and the inner cone will descend. I can easily do this by laying an obstacle along the stream of gas; for at the end of it there will be no more current than you would find over the stern of a boat anchored in midstream. I take this obstacle, in the form of a glass rod fixed centrally along the current of gas; I push it up until it touches the tip of the inner cone, and then pull it down again. This is what has happened: The cone has followed the rod into the tube, and remains attached to it; and the cone is inverted. That is easily understood. It is only at the tip of the rod that the current is slowed down. There only is the rate of ascent of the stream less than the rate of inflammation. The tendency in every other part of the stream is for the cone to go to the top; hence the inversion. (See fig. 1 B.)

We can get a still more convenient apparatus by a modification of the first method. Instead of choking the bore of the single tube by a constriction, we may use two tubes of different diameter, one sliding within the other. This apparatus is shown in fig. 1, at C,; *a* being the wider tube, *b* the narrower one. The two tubes are connected by an india-rubber collar *c*, and kept steady by the brass guide *d*. The outer tube can be slid up and down the inner one as desired. If we place this apparatus over a Bunsen burner, and turn on the gas, we shall have a tolerably rapid upward current in the inner tube; but as soon as the gas emerges into the wider one, its velocity will, of course, diminish. The consequence is that, if we now light the gas, and gradually increase the air supply, the inner cone will descend until it reaches the orifice of the narrower tube; but at that point, meeting with the rapid stream, its progress is arrested, and it remains perched on the end of the tube. By sliding the tubes we can thus separate the cones any desired distance, or we can bring their orifices level, and restore the original flame. Lastly, we can reverse the experiment, for we can begin with a two-coned flame burning at the protruding end of the narrower tube, and by sliding up the wider tube detach the outer cone, and carry it upwards. (See fig. 1, D.)

Having now learnt the relation of flame to explosion, having discovered that flames have separable regions of combustion, and having armed ourselves with an appliance for dissecting the flame, we may proceed to discuss the main question.

I do not intend to enter seriously into chemical details, but there are one or two simple points to which I must draw your attention. Flame, we see, is a region in which chemical changes are taking-place with the evolution of light. It is to be expected, therefore, that the character of a flame, its structure and appearance, will vary according to the chemical changes that give it birth; and we should naturally anticipate that the more complex the chemical changes, the more complex would be the flame. The kind of complexity to which I now refer is shown by the table:—

Name.	Composition.	Products.	
		Partial Combustion.	Complete Combustion.
Hydrogen	..	Water	Water
Carbon monoxide	Carbon and oxygen	Carbon dioxide	Carbon dioxide
Carbon	..	Carbon monoxide	Carbon dioxide
Cyanogen	Carbon and nitrogen	Carbon monoxide and nitrogen	Carbon dioxide and nitrogen
Hydrogen sulphide	Hydrogen & sulphur	(?)	Water and sulphur dioxide
Hydrocarbons	Hydrogen & carbon	Carbon monoxide Carbon dioxide Hydrogen & water	Carbon dioxide and water

In the first column are the names of five combustibles; their chemical composition is stated in the second column. All these substances in burning combine with the oxygen of the air. The case of hydrogen is the simplest. This gas, when it burns, unites with half its volume of oxygen, and forms steam. The process is incapable of any complication. We might predict, therefore, a very simple structure for a hydrogen flame. The same is true for the next gas, carbon monoxide, which, although a compound, unites at once with its full supply of oxygen, and burns—forming carbon dioxide. The third combustible, carbon, presents a new feature. In burning, it can combine with oxygen in two stages—forming in the first instance carbon monoxide, which, as we have just seen, can itself combine with more oxygen to form dioxide. We cannot vaporize carbon and use it as a gas, so that we shall not actually deal with this example. But the next combustible on the list, cyanogen, will serve almost as well; for it is a compound of carbon with nitrogen, and nitrogen is under ordinary circumstances practically incombustible. To use cyanogen is thus much the same as to use carbon vapour. We may expect some complexity in the cyanogen flame, in consequence of the fact that carbon can burn in two steps. The next combustible, hydrogen sulphide, presents a further degree of complexity. It is composed of two elements, each of which is combustible on its own account. Lastly, we come to the great class of hydrocarbons, which includes all ordinary combustibles—oil, tallow, wax, petroleum, and coal gas. The carbon and hydrogen are both separately combustible elements, and one of them—carbon—is, as we have seen, combustible in two steps.

We will now consider the problem in its simplest aspect. For this purpose I choose carbon monoxide. I should select hydrogen were it not for the fact that its flame is almost invisible. We will allow a stream of carbon monoxide to issue from the circular orifice of this glass tube. Lighting the gas, we get a blue flame. On examining this flame closely, we perceive that it is simply a hollow conical sheath of pretty uniform character. I need scarcely demonstrate that it is hollow; but I may do so in a moment by using Professor Thorpe's simple device of thrusting a match-head into the centre of the flame—a pin passing through the stick of the match, and its ends resting on the tube. The match-head is now thrust well up inside the flame, and you observe that it remains there sufficiently long without burning to make it quite clear that there is no combustion within the cone. The conical form of the flame is easily explained. As the stream of gas issues from the tube, the outside portions become mixed with the air and burn. The inner layers must

successively travel farther upwards, like the successive tubes of a telescope, before they can get enough air to burn, and in this way we arrive at the conical form.

There still remains one thing to account for, and that is the luminosity and colour of the flame. The questions here involved are perhaps the most interesting of all; but they are complicated, and I will not say more than a few words about them. The most obvious answer to the question, "Why is the flame luminous?" is to say that the heat developed during the chemical combination raises the product of combustion to a temperature at which it glows—a "blue heat" in the present case. Now, if we put a thermometric instrument into the carbonic oxide flame, it does not register at any point so high a temperature as 1500° C.; but if we take carbon dioxide and heat it in a tube by external heating to 1500° C., we get no signs of luminosity whatever. On these grounds, several eminent investigators have been led to abandon the simple explanation above given, and to say that the luminosity of a carbon monoxide flame must depend not on the heat of chemical combination, but on something in the nature of electrical discharges between the combining substances, which discharges produce the disturbances of the ether perceptible as light. This view seems to be fraught with a fundamental error. The temperature registered by any instrument introduced into a flame is an average temperature, uncorrected for losses by conduction. It is not the temperature of the newly-formed gas, but of the mixture of that and the unburned gases. If we had a very small instrument which we could apply to the particles of newly-formed gas, we should undoubtedly find them at a very much higher temperature than any indicated by the ordinary thermometric apparatus; and it is not unlikely that the temperature would be several thousand degrees—approximating, indeed, to the temperature at which we arrive by calculation from the heat of combustion of the gas and the heat capacity of the product. We cannot say that the flame is luminous from some other cause than simple hotness; for we have no means of seeing whether carbonic acid glows when raised by external heating to a temperature of several thousand degrees.

At the same time, one cannot help remarking on the similarity between such a flame as that of carbon monoxide and the appearance presented by an attenuated gas when submitted to the electrical discharge in a Geissler tube. I have here such a tube, containing carbon dioxide, and I have placed a mask over it, so that we see a long triangular piece of it. When I pass the discharge, it lights up, and presents an appearance strikingly like that of our conical flame of carbon monoxide. There may be a close relationship between the phenomena; but we cannot affirm it yet. No doubt we shall soon learn a good deal more about both phenomena.

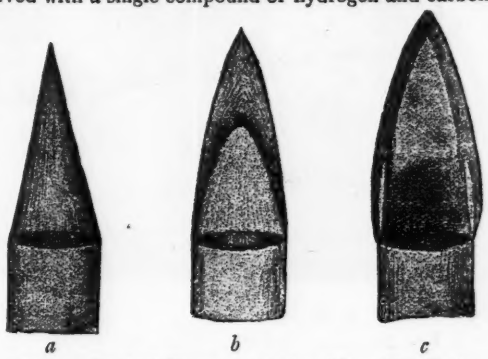
We have now done with the simplest kind of flame. We see that it consists of a single conical sheath of combustion, at every point of which the same chemical change is taking place, and every point of which has, in consequence, the same appearance. We now pass to the cyanogen flame. This flame is one of remarkable beauty. It consists of two distinct parts—one a rose or peach-blossom coloured cone, surrounded by a paler cone, which is bright blue where it is near the inner cone, and shading off to a kind of greenish grey. What is the cause of this double structure? It might be that part of the gas is burning round the orifice, and the rest farther out in the second cone; but a similarity of the chemical processes in the two parts of the flame is rendered improbable by difference in colour. The only satisfactory way of answering the question is to separate the cones, and analyze the gases in the intervening space. This we can easily do in the cone-separating apparatus.

I now form the flame at the top of our cone-separating apparatus, and supply a certain amount of air along with the cyanogen; and the rose-coloured cone contracts somewhat. The gas burning there now gets its air supply easily, and has not to wander outwards. If I still further increase the air supply, and make the ascending mixture explosive, the inner cone begins to descend into the tube, and passes down until its progress is checked at the narrow tube, where the up-rush of gas is more rapid. We have now the cyanogen flame dissected; and by taking out a sample of the gases from this interconal space and analysing it, we shall find what chemical change has taken place in the inner rose-coloured cone. The analysis shows that what takes place is the combustion of the carbon of the cyanogen to form carbon monoxide almost exclusively. The carbon monoxide then ascends; and when it meets more oxygen in the outer air, it burns in a second cone to form carbon dioxide.

Reverting then to the flame of the pure unmixed gas burning at the top of a tube, we see that the gas and air will interpenetrate. When there is just enough oxygen to burn the gas to carbon monoxide, we get the rose-coloured cone; and outside it, where this carbon monoxide gets more air, we have a second cone. The two-coned structure corresponds then to two chemical stages of combustion.

Now we might go further and anticipate that, if we supplied a very large quantity of air to the cyanogen, as in a blowpipe, the two-coned structure would disappear, for the carbon should be burnt up at once to the ultimate product—viz., carbon dioxide. We can easily try this. I will separate the two cones again in our apparatus, and increase the air supply still further. When I do so, the second cone gradually fades away, and now the whole of the combustion is taking place at the end of the inner tube. Though this is so, the flame is not quite a simple cone. It is surrounded by a greenish halo. This halo is due, I believe, as Professor Dixon has suggested, to the fact that the nitrogen of the cyanogen is not, strictly speaking, incombustible. This has been proved by Mr. Crookes in his beautiful air-flame; and, besides, the greenish halo is frequently noticeable in cases of combustion where oxides of nitrogen are present.

Keeping to our list, we ought next to deal with the combustible hydrogen sulphide, or sulphuretted hydrogen. This gas is composed of two separately combustible elements, each burning in one stage. The flame is, as might be expected, two-coned; but I will not dwell upon this case, partly because it is not yet fully worked out, and partly because any prolonged experimenting with this gas would, I feel sure, be resented even by the most indulgent audience. I am obliged, therefore, to pass to compounds of carbon and hydrogen, in which there are not only two combustible elements, but one of them, as we have seen, combustible in two chemical stages. Here we have an almost unlimited choice of materials, for we come among the combustibles which ordinarily supply us with light. I shall, for the sake of convenience, use coal gas. This is really a very complex combustible, consisting one-half of hydrogen, and the other half of at least a dozen different compounds of carbon and hydrogen. But experience shows that the chemical phenomena attending its combustion are quite of the same character as those to be observed with a single compound of hydrogen and carbon.



a *b* *c*

FIG. 2.—Typical Flames: *a*, Carbon Monoxide, Single Coned; *b*, Cyanogen, Two Coned; *c*, Small Coal-Gas Flame.

It will, I imagine, be scarcely necessary for me to point out the various parts which are to be seen in the flame of a candle or of coal gas. On the diagram fig. 2, there is shown at *c* the picture of a somewhat small coal-gas flame, produced at a circular orifice. Four distinct parts are to be recognized. First, the central and darkest part; this contains the unburnt gas, just as we saw in the case of the carbon monoxide flame. Perhaps it is wrong to speak of this at all as part of the flame, for it is really a region of no flame. At the base of the flame are two blue strips embracing the lower portion of the flame. This appearance results from the mode in which we view the flame. The strips are really due to a sheath which goes right round the flame like an uninterrupted calyx. It looks bright where we view it edgewise. When we look through, as in the middle of the diagram, it is very pale indeed. Next we have to notice a bright yellow patch—so bright in the reality as to mask the other parts. Though it looks bright and dense, it is merely a hollow sheath. Lastly, there is surrounding the whole flame a pale mantle of flame of very slight luminosity, and of an almost indescribable tint, which perhaps we may call lilac. These parts are discernible in all ordinary flames. They do not always occupy the same relative space. In the flame given by a good gas-burner the yellow part is made by intention as large as possible; in the flame of a piece of string or a spirit-lamp the outer investing mantle is very distinctly developed.

If we are to understand flame, then, we must find an intelligible explanation of the existence of these distinct parts of its anatomy. One important point we can settle at once. An ordinary flame owes its differentiated structure to the slowness with which it gets the oxygen necessary for combustion. If there is an immediate and sufficient supply of air, the characteristic structure disappears. This we can secure by making the stream of gas sufficiently rapid. I have here a steel cylinder containing coal gas at very high pressure. If I allow the gas to escape slowly, we get a flame in which we should find the ordinary parts. But if now I allow the gas to issue quickly, the admixture with air is so rapid that we have a pale flame quite undifferentiated in structure. We arrive at the same result by introducing a strong current of air into an ordinary flame, as in the blast blowpipe. The flame is then homogeneous, as in the previous case.

We see, therefore, that the structure of an ordinary gas-flame is largely dependent upon the slowness with which the gas gets the air necessary for its combustion. There is still one other evidence of this. It is obvious that a very small flame will have a much better chance of getting its oxygen quickly than a larger flame. It is, I am sure, within everyone's knowledge that a very tiny gas-flame is blue; and, as a matter of fact, we learn a great deal about flame structure by carefully watching

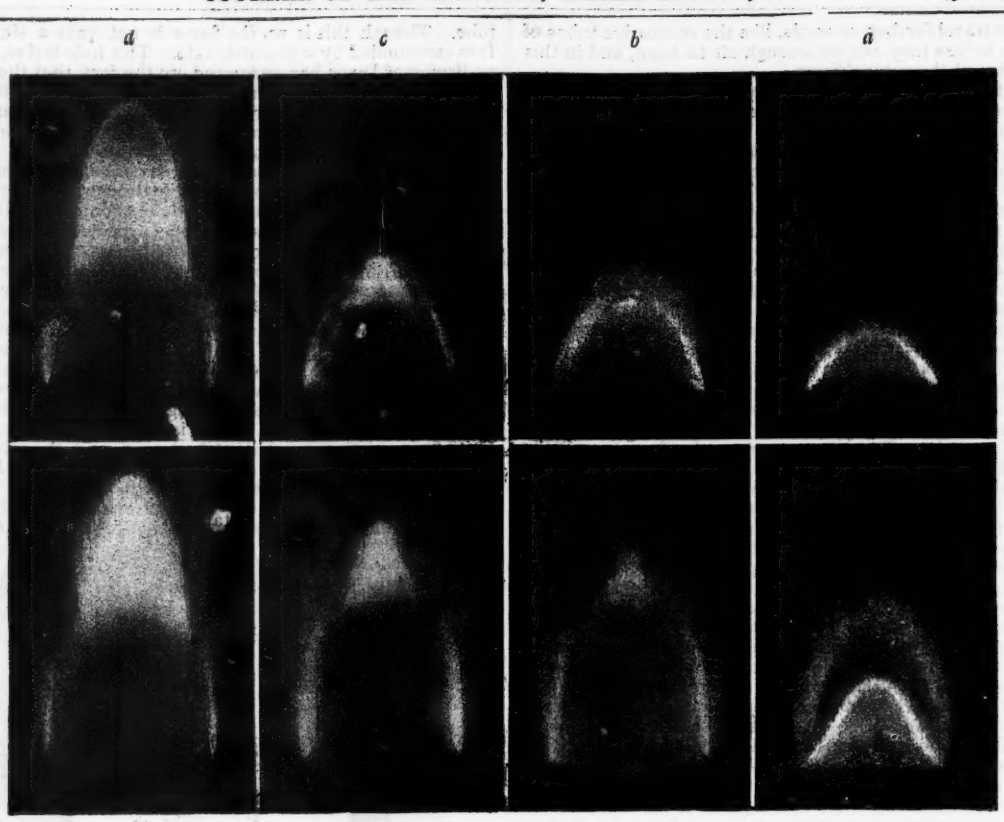


FIG. 3.—*a*, *b*, *c*, *d*, Flames with Successively Increasing Quantities of Coal Gas; *d*, *e*, *f*, *g*, Flames with Fixed Supply of Coal Gas and Successively Increasing Quantities of Air.

the development of a very small flame. I am going to show you a series of photographs of actual flames.

The first slide (fig. 3) shows at *a* a tiny gas-flame burning at the end of a glass tube. It consists of a bright blue cone surrounded by a fainter one; both being quite continuous. By putting in another slide, and using the "dissolving view" arrangement of the lantern, I will show the effect of turning on the gas. The flame *b* is larger; and there is now observed a third region in the flame—viz., a patch of bright yellow at the tip. The original cones are still there, but are slightly interrupted at their apices. Turning on more gas, the flame again enlarges, as shown by *c*, the yellow patch increases in size, and the original cones are further broken into. But the yellow patch is indented at points corresponding to the inner cone, which, as it seems, is striving to maintain its integrity. Turning on still more gas, we have now a great preponderance of yellow; the original blue cone is reduced to mere vestiges; and the outer cone forms a faint surrounding to the whole flame (see *d*). This is flame as we ordinarily know it. I wish now to show you another series of changes. We must suppose the gas supply fixed, and the photographs I will show represent the changes which take place in the flame when air is gradually added beforehand to the coal gas. The supply of coal gas is, I repeat, the same in all cases. The first change is that the yellow patch diminishes in extent (see *e*). If I add more air, it diminishes still further; and the inner cone is growing in distinctness (see *f*). If I add a trifle more air, the yellow patch disappears altogether, and we have now complete and distinct inner and outer cones (see *g*). I think you will admit that these two sets of photographs show a close correspondence; and you can see it more plainly if I throw them on to the screen in a group. There is really nothing surprising in this similarity. The smallest gas-flame has obviously the best chance of getting air; and when it gets enough, it burns in a two-coned flame. The same effect is reached by adding air to the gas before it is burned. If we have a larger gas-flame, it has, of course, less chance of getting its oxygen rapidly; and we see that, in whatever way we starve the flame of oxygen, we lose the simple structure, and come upon the yellow patch.

Now, when we come to inquire into the chemical changes occurring in such a flame, we may, I think, feel confident that the chemical actions which determine the existence of the blue cone and the outer cone are the same, whether these cones are complete, as in a small flame, or fragmentary, as in a larger one. If that is so, we can soon make progress; for, as I have shown you, we can easily separate these cones, and find what is going on in each. I again use the cone-separating apparatus. First we have an ordinary luminous gas-flame at the top of the outer tube. I pass in air, the flame loses luminosity, and it rapidly becomes an ordinary two-coned Bunsen flame. I push the air supply further; the inner cone enters the tube, and descends until it rests on the end of the inner tube. The two cones of a hydrocarbon flame are thus widely separated. We can aspirate a sample of the gases, and see what changes have taken place in the first region of combustion. The result is one that we might await with curiosity, for we have now a competition. There are both carbon and hydrogen to burn, and not enough oxygen to burn both; and the question is, Which will have the preference? I think I may say that the off-hand opinion of any chemist who has not had his attention drawn specially to this point would be that the hydrogen would easily have it. But, as a matter of fact, this question was settled long ago by Dalton, and in the opposite sense; and in the present case analysis would confirm this conclusion. If we analyzed the gases, we should find that all the carbon is burnt in the first cone, while a considerable part of the hydrogen passes through unburnt. The change is not quite so simple as these words might imply, as will be seen from the actual figures of analysis:—

Analysis of Interconal Gases from a Coal-Gas Air-Flame.

Carbon monoxide	8·7	17·9 combustible gases.	
Hydrogen	9·2		
Carbon dioxide	4·1	20·1 burnt gases.	
Water	16·0		
Nitrogen	62·0		
	100·00		
Amount of air used	78·5	Oxygen	16·5
		Nitrogen	62·0
Amount of air still needed	42·9	Oxygen	9·0
		Nitrogen	33·9

About two-thirds of the carbon is burnt to form carbon monoxide, one-third to form carbon dioxide, while rather less than two-thirds of the hydrogen is burnt, and more than one third remains altogether unconsumed. We need not dwell on the details, more especially as the analysis of the gases was made after they had cooled. The four gases—carbon monoxide, carbon dioxide, steam, and hydrogen—act upon one, as a matter of fact, while they are cooling down, and the distribution of the oxygen that we find in our analysis of the cold gas is not precisely that which exists in the gases as they just leave the inner cone. We shall only draw a general inference, and it is one that has been recently verified in a very complete manner by Professor Dixon and his pupils. This inference is simply that the carbon in the inner cone is for the most part burnt to carbon monoxide, and that the hydrogen is to a considerable extent set free. So much, then, for the inner cone. The outer cone is due simply to the burning of the carbon monoxide and hydrogen which escape from the inner cone. When they meet with oxygen in the free air, their combustion is completed. We are now in possession of the explanation of the two-coned gas-air flame. Applying this to the tiny gas-flame to which no air has been previously added, we see that the inner cone will be formed where the air has penetrated the gas sufficiently to produce such

a gaseous mixture as we had in the lower cone of our separator. The gases coming from this burn farther out when they meet with more air, and form a second cone.

The last thing we have to explain in the ordinary gas-flame is the production of the yellow luminous patch, which, from the illuminating point of view, is the most important feature of all. I need scarcely remind you that the general opinion is that this patch in the flame is due to glowing carbon in a solid and very finely-divided state. The familiar fact that a cold object introduced into the yellow part becomes coated with a black solid deposit, composed almost wholly of solid carbon, confirms this view. That this carbon or soot is solid in the flame, is shown by the fact that it is deposited as a solid even when a highly-heated object is placed in the flame; and there are other proofs —some of them very pretty—which I cannot show for lack of time and of a means of magnifying.

This explanation is due to Davy; and it constitutes his most celebrated discovery on the subject of flame. He describes it in the following words:—

When a wire-gauze safety-lamp is made to burn in a very explosive mixture of coal gas and air, the light is feeble, and of a pale colour, whereas the flame of a current of coal gas burnt in the atmosphere, as is well known by the phenomena of the gas-lights, is extremely brilliant. . . . In reflecting on the circumstances of the two species of combustion, I was led to imagine that the cause of the superiority of the light of the stream of coal gas might be due to the decomposition of a part of the gas towards the interior of the flame where the air was in smallest quantity, and the deposition of solid charcoal which, first by its ignition, and afterwards by its combustion, increased in a high degree the intensity of the light; and a few experiments soon convinced me that this was the true solution of the problem. I held a piece of wire gauze of about 900 apertures to the square inch over a stream of coal gas issuing from a small pipe, and inflamed the gas above the wire gauze, which was almost in contact with the orifice of the pipe, when it burned with its usual bright light. On raising the wire-gauze so as to cause the gas to be mixed with more air before it inflamed, the light became feebler, and at a certain distance the flame assumed the precise character of that of an explosive mixture burning within the lamp. But though the light was so feeble in this last case, the heat was greater than when the light was much more vivid; and a piece of wire of platinum held in this feeble blue flame became instantly white hot. On reversing the experiment, by inflaming a stream of coal gas and passing a piece of wire gauze gradually from the summit of the flame to the orifice of the pipe, the result was still more instructive; for it was found that the apex of the flame intercepted by the wire gauze afforded no solid charcoal, but in passing it downwards solid charcoal was given off in considerable quantities, and prevented from burning by the cooling agency of the wire gauze. At the bottom of the flame, where the gas burnt blue in its immediate contact with the atmosphere, charcoal ceased to be deposited in visible quantities.

Only one attempt has been made to disturb the conclusion here drawn by Davy. In 1868, Professor E. Frankland, to whom we are indebted for many important discoveries respecting flame, came to the conclusion that the light-giving agency in flames was not solid carbon, but certain complex vaporous compounds of carbon and hydrogen. I regret very much that time will not admit of my detailing the evidence in favour of this view, or the counter-evidence by means of which most chemists have been persuaded that Davy's explanation was, after all, the correct one. It is, however, right to remark that Professor Frankland not only adheres to his own view, but has promised to adduce further evidence in its favour.

Let us, at any rate for the present, stick to the opinion of the majority, and admit that the bright light of ordinary flames is due to incandescent particles of solid carbon. The next question is, How does this carbon become separated? This question is dealt with by Davy, but in language of some ambiguity. He says: "I was led to imagine . . . . . that it might be due to the decomposition of a part of the gas towards the interior of the flame where the air was in smallest quantity, and the deposition of solid charcoal which, first by its ignition, and afterwards by its combustion, increased in a high degree the intensity of the light." Whatever these words may have been intended to mean, or whatever interpretation is the fair one, it is certain that Davy's explanation was soon presented as if it implied lack of air to be the chief cause of carbon separation. As there was a large quantity of hydrocarbon, and only a small amount of oxygen in the central parts of the flame, the hydrogen, it was said, being the more inflammable element, will seize upon this oxygen, and leave the carbon uncombined. The fact that this version was given by Faraday lends some countenance to the belief that it was a fair representation of Davy's view.

Now this doctrine was really incompatible with facts known, though apparently not widely known, at the time. I have already referred to the fact that Dalton, at the beginning of the century, showed that when a hydrocarbon is exploded with a supply of oxygen insufficient to burn both the hydrogen and the carbon, it is the carbon, and not the hydrogen, that has the preference. If, therefore, we follow Davy in regarding flame as a tethered explosion, we cannot explain the separation of carbon as being due to the preferential combustion of the hydrogen. This fact was clearly pointed out by Kersten in 1861; but, notwithstanding this, and other investigations tending to the same conclusion, the old view has somehow kept its ground down to the present day.

We must now turn to the alternative explanation. It is supplied by the words, and I think by the intention, of Davy. He says that the carbon separation might be due to the decomposition of the gas towards the interior of the flame. If this decomposition be not due to chemical action, it must be due to heat; and certain it is that hydrocarbons, when strongly heated, do decompose, and do deposit carbon. Here is a result of this action occurring on the large scale. This gas-carbon, as it is called, is deposited in gas-retorts owing to the action of intense heat on the hydrocarbons of the gas.

In another place, Davy says: "I have shown . . . that the light of common flames depends almost entirely upon the deposition, ignition, and combustion of solid charcoal; but to produce this deposition from gaseous substances demands a high temperature." This explanation of carbon separation in flames seems perfectly adequate, and free from objection. There is, as we have seen, surrounding all ordinary hydrocarbon flames a shell of almost non-luminous combustion. The gas which passes upwards within this shell must be highly heated, and in the absence of air will be decomposed so as to deposit solid carbon. This carbon is intensely heated, and glows; and as it reaches the air it will burn to form carbon dioxide. The fact that the upper parts of flame are most luminous in itself indicates that the more we roast the gas the more do we separate the carbon; and there are other proofs I cannot stop to explain.

We have now pretty well reached the end of the explanation of the structure of ordinary luminous flames; and I will show you an experiment which epitomizes the explanations that have been given. We turn once more to the cone-separating apparatus, and use as fuel a substance particularly rich in carbon. This substance—benzene—is a liquid, so I shall have to vaporize it by means of a current of air. When I apply a light to this current of air strongly impregnated with benzene, we get, as you see, a very bright flame. This flame exhibits the usual structure. This is one extreme. Now I will reduce the amount of benzene vapour very rapidly without altering the air, and we shall get the other extreme—that is, a scarcely luminous flame consisting of one single cone. The whole of the combustion is now taking place in a single cone of flame. If I still further reduce the benzene, this flame enlarges slightly, and becomes paler. There is now excess of air. A little less benzene still, and the flame rises from its perch and disappears; we have passed the limits within which combustion is possible. Let us next move in the other direction, and gradually increase the supply of benzene to the single cone. It becomes smaller and brighter as we proceed up to a certain point. At length we evidently have more benzene than there is air to burn, and now the second cone appears at the top of the tube. By sliding the tubes we can unite the flame so as to make a Bunsen flame. Separating the cones again, let us add still more benzene. The result is very remarkable. The two cones remain intact; but stretching between them are thin luminous streaks of glowing carbon. The excess of benzene is being decomposed by the heat, so that the carbon separates and glows. The more benzene I add, the broader do these streaks become, until eventually the inner cone ascends, the luminous streaks coalesce, and we have the ordinary luminous hydrocarbon flame.

I have now put before you the considerations and methods which will serve, I believe, for the elucidation of all problems of flame structure. I am not aware, at any rate, of any flame which does not accord with the general principles which I have explained to you.

There are many other flame problems besides those which relate to mere structure. One of the most interesting of these concerns the coloration of flame. I will refer to it for a moment only to show how closely this question is connected with the points we have been discussing. I have here a gas-flame to which I feed air until its yellow luminosity has disappeared. If I add to the air supply the fine spray of a dissolved copper salt, the flame assumes a green tint characteristic of the metal. This green tint seems to belong to the whole flame; but if we dissect it by the apparatus already so often used, we find that the tint is developed only in the outer cone. It is due, in fact, to oxide of copper, which can only exist on the outside of the flame. Similar peculiarities are noticed with some other coloured flames; and it is hoped that their study, which leads us into the domain of spectrum analysis, will yield some interesting information on points which are at present very obscure.

I have directed your attention this evening to terrestrial flames of small dimensions; but, in conclusion, I should like to remind you that at one time there were probably quite different flames upon this earth. The globe we inhabit is in the process of cooling and of oxidation. At one time we believe—in fact, we know—that it was incandescent. If we take a chemical retrospect, and imagine, as we recede in time, our present cool earth becoming hotter, we may follow out some interesting changes. We should soon reach a temperature too high for the persistence of liquid water. Our oceans would be evaporated, and surround the globe as an envelope of steam. In remoter times and at higher temperatures this steam could not exist even as steam, but would be dissociated into hydrogen and oxygen. At that time, too, many of the elements now existing as oxides in the solid crust of the earth would be floating in a gaseous state in the vast atmosphere. Let us stop our retrospect at this point, and look towards the present with a cooling earth. At a certain point, chemical combination must have begun in the fringe of the ancient atmosphere; and it must have been the scene of some colossal chemical activities—the hydrogen and vaporous metals flashing into their oxides. On

gravitating to hotter regions, these combinations may have been again undone, and the elements sent again into circulation. How long such a period may have lasted, we needly scarcely stop to ask. If the retrospect is reasonable, it is enough. It is interesting to think how such an earth as we have pictured must have resembled the sun as we know it at the present day.

There was formerly a chemical theory of the sun, which ascribed both its heat and light to the act of chemical combination. That theory has long since been refuted and discarded, and with it ordinary laboratory chemistry banished from that luminary as altogether unsuited to its high temperature. There is cause, I think, to ask if this is quite warrantable. We know extremely little of chemistry at high temperatures; but if the sun could be shown to have its reasonable share of oxygen, we might well ask if its surface phenomena were not largely ascribable to ordinary chemical activities, and of the nature of flames. It is certainly remarkable, when we consider the unity of plan in which heavenly bodies are seen more and more to move and have their being, that the sun should not exhibit the possession of its fair share of that element—oxygen—which has ruled the chemistry of the earth throughout all geological time, and long precedent ages of its evolution. But this is ground which the terrestrial chemist must tread with care. He still has many unsolved problems lurking in the flame of a common candle; and flame, wherever we find it, is still a mystery. "The power of fire or flame," says Carlyle, "which we designate by some trivial chemical name, thereby hiding from ourselves the essential character of wonder that dwells in it as in all things, was with the old northmen Loke, a most swift subtle Demon of the brood of the Jötuns. The savages of the Landrones Islands, too (say some Spanish voyagers), thought fire, which they never had seen before, was a devil or god, that bit you sharply when you touched it, and that lived upon dry wood. From us, too," adds Carlyle, "no Chemistry, if it had not stupidity to help it, would hide that flame is a wonder."

The Forthcoming Congress of Hygiene and Demography.—The eighth Congress of Hygiene and Demography is to be held in Budapest next September. It will open on the 2nd, and the sittings will be continued on the five following days. A number of excursions are fixed—a visit to Constantinople being in contemplation. The President of the Congress has not yet been appointed.

Alderman Shammon, who has been closely connected with the work of the Birmingham Corporation Water Committee since 1875, died at his residence at King's Heath, last Thursday, after a painful and lingering illness. In 1881 the deceased gentleman was appointed Chairman of the Finance Sub-Committee of the Water Committee; and more recently he served with Sir Thomas Martineau and Alderman Lawley Parker on the Parliamentary Sub-Committee. The amount of labour involved in getting the new Water Bill through Parliament was enormous, and of that work Mr. Shammon bore his full share.

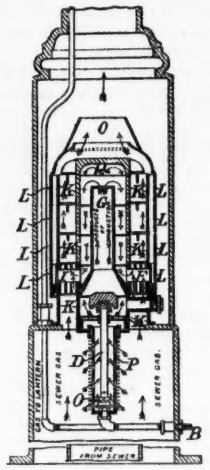
Pamphlets, &c., Received.—"Calvert's Almanack and Workshop Companion for 1894." (Manchester: J. Calvert and Son.) As this is the 21st year of publication of this almanac, its contents have evidently been appreciated by the class of artisans and handicraftsmen, for whose use they have been compiled. The present issue keeps up its character for utility.——A well-executed pamphlet, giving an interesting account of the origin and progress during the past century and a half, of the firm of Messrs. James Milne and Son, Limited, of Edinburgh and London, with portraits of the founders and present Directors, and views of the machine and other shops at the works.——Sugg's "Gas Engineer's Pocket Almanack and Lighting Table for 1894," containing, as in previous years, illustrated descriptions of the various kinds of gas apparatus manufactured by Messrs. W. Sugg and Co., Limited, together with blank forms for entering particulars of working and other memoranda, and a collection of useful tabulated information.

Soundness and Working Qualities of Steel.—At a recent meeting of the Mason College Engineering Society, a paper on the above subject by Messrs. Korb and Turner was read. The authors stated that fluid steel has the power of dissolving more than its own volume of gas, which consists chiefly of hydrogen, nitrogen, and carbon monoxide; the fluid metal behaving like an ordinary solvent, such as water in which gases are dissolved. The quantity of gas dissolved is greater in Bessemer than in Siemens steel, and least in crucible steel; this helping to account for the superior quality of the latter, as dissolved gases tend to produce brittleness in the metal. The steel in solidifying contracts and forms a hollow or pipe in the upper part of crucible steel ingots; the gas acts in an opposite direction, and tends to dilate the steel, and so prevent the piping, which is most pronounced in crucible steel, and not found in Bessemer metal. Hence the shape and size of pipe in ordinary crucible steel ingots affords a good indication of the soundness and quality of the steel. Steel which is overheated during working becomes crystalline, and is spoiled. This is due to the fact that the solid steel consists of a network of pure iron, in which are enclosed carbides, phosphides, and sulphides of iron, which are more readily melted than the pure metal. If the steel is heated to nearly its melting-point, the enclosed parts fuse while the network is unaltered; and a granular structure, accompanied by brittleness, is the result.

REGISTER OF PATENTS.

Sewer Ventilation by Means of Gas-Heating Apparatus.—Holman, S., of Great George Street, Westminster. No. 20,781; Nov. 16, 1892.

This invention is more especially intended for use in the ventilation of sewers wherein the foul gases are drawn therefrom by gas-burners heating a stove or furnace; and the principal object of the invention is to prevent any danger of explosion, due to the ignition of combustible gases which may be present in the sewers. This is attained by means of an arrangement wherein the gas-flames of the stove or furnace are provided with passages, distinct and separate from the main bulk of those through which the air or gases from the sewer pass.



As shown in the engraving, the burner is enclosed in a chamber, from which a tube G rises—surrounded by another tube or series of superposed rings K, provided with a cover H; so that the products of combustion from the furnace or burners pass up the inner tube, and down between it and the surrounding tube or rings, and into the passages I, up through the holes J, and thence to the outlet O. This outlet is formed by rings, which rest upon the topmost ring L surrounding K, and are contracted to the necessary extent to give the required draught. The air and gases from the sewer pass up through the last-named series of rings to the exit chamber or column; the apparatus being enclosed in a cylinder provided with a door. The rings L, surrounding the rings K, are to prevent radiation of heat.

The burner or furnace is shown as consisting of an atmospheric burner; the gas-pipe B admitting gas to the tube D, which is provided with holes, by which air is drawn in. A deflector is placed upon the top of this tube, the flames issuing from the holes therein. In the ring in which the passages I are formed, are holes by which air and gases from the sewer can also pass up. F is a sight-tube, provided with a glazed cap, through which the burner can be observed, and by removing which the burner can be lighted.

The tube D is shown as being surrounded by a perforated chamber P; the perforations being covered by wire gauze. This chamber opens into the chamber A; and the air passes therefrom into the chamber, through plates with perforations, preferably covered with wire gauze, to prevent danger of back-firing.

Atmospheric Gas-Burners.—Slaytor, J., of Doncaster. No. 23,303 Dec. 17, 1892.

This invention, which relates to atmospheric gas-burners, has for its object to prevent "lighting-back" or "burning-down" in such burners, by securing a ring in the pipe which conveys the mixed air and gas from the nozzle to the jets where the mixture is to be burnt. The ring, which is of suitable length and thickness, fits the pipe tightly; and the end of it nearest the gas-nozzle is flat; while the opposite end is turned approximately conical externally, so as to form a projecting lip in the chamber or tube. The ring is preferably secured a short distance away from the gas-nozzle. There is a screen of wire gauze a little further up the tube (between the ring and the gas-jets), so as to obtain greater security, and to cause the burner to right itself in case the gas lights below the gauze.

Deodorizing the Exhaust of Gas-Engines.—Mellin, G. F., of Fall River, U.S.A., and Reid, W. P., of Victoria Street, Westminster. No. 2523; Feb. 4, 1893.

In order to prevent the offensive smell of the gaseous products discharged from the cylinder of a gas-engine, the patentees propose to pass the exhaust of the engine through a long pipe, or a pipe bent in zig-zag or as a coil, or else through a group of pipes or passages presenting an extended cooling surface, so that the vaporous ingredients of the exhaust are condensed. The gases discharged from the condenser are then caused to bubble through a shallow depth of water containing in solution deodorizing substances—such, for instance, as sulphate of iron.

Liquid Meters.—Thompson, W. P.; communicated from G. E Samain, of Paris. No. 2816; Feb. 8, 1893.

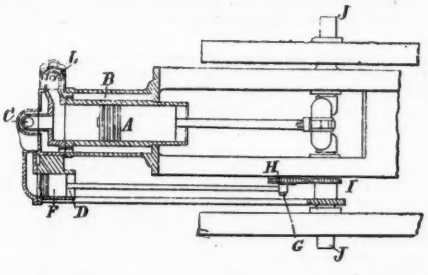
This invention relates to that class of liquid meters in which the pistons move freely, and where the play of each cylinder causes the distribution in the other cylinder. It consists "in the use of a single cylindrical body, divided by a partition, in such a way that the two cylinders of the meter form a prolongation of each other, and in a peculiar arrangement of the slide-valves."

The cast-iron body of the meter is divided in the centre by a partition, in such a way as to form two cylinders (placed end to end), in

which the measuring pistons move. Each of the pistons has, on its external side, a tubular prolongation, closed at the end, and capable of entering freely into a projecting sheath, arranged to allow it to pass, and to form part of the cover in which it moves. In this tubular prolongation, a rod is placed, which may move freely therein, and which passes through the central part of the piston. This rod is provided at its ends with shoulders, which, at the end of each stroke of the pistons, are slightly displaced; and this movement is transmitted to the slide-valves in the following manner: On each side of the partition, levers are arranged, one of which is hinged on a pivot placed above the axis of the other cylinder, and the support of which also serves as a guide to the first lever. In this manner, the movement imparted to the two levers at the pivots, by the sliding-rods, regulates the inverse movement of their upper extremities, and, consequently, of the valves which they operate. These valves, which are placed on the ports, are provided ith extensions, arranged in such a way as to cross one another, so that the right-hand valve is operated by the left-hand lever, and the left-hand one by the right-hand lever, which, for this purpose, terminates in a fork shape. Finally, the extended portions of the slide-valves are arranged in such a way that, at the points where the upper extremities of the levers which operate them enter, they close the openings through which they pass.

Gas-Engines.—Bellamy, A. R., of Stockport. No. 2857; Feb. 9, 1893.

This invention relates particularly to improvements in gas motor engines which have the "Otto" cycle of operations; the chief object being to reduce the terminal pressure of the effective stroke without reducing the initial pressure of the explosive fluid mixture.



A is the piston; B, the power cylinder; C, the air-inlet valve; D, a small pump cylinder; E, gas admission-valve to the pump cylinder D; F, the pump-piston; G, a second crank-shaft; H I, toothed wheels; J, the main crank-shaft; K, the valve controlling the admission of gas to the power cylinder B; L, the exhaust-valve; and M, the side shaft from which the several valves are operated.

The following is the improved cycle of operations: First stroke—The piston A, during its out-stroke, draws into the cylinder B, from the air inlet-passage controlled by the valve C, a full charge of air. Second stroke—The piston A, during a portion of its in-stroke, expels, through the air-valve C or exhaust-valve L, part of the air drawn in during the first stroke; and during the remainder of its in-stroke (while the valve C is closed), it compresses the air, and an injected charge of gas or hydrocarbon vapour. This injection is effected by means of the piston F of the small pump cylinder D, which is in communication with the gas supply and also the gas-inlet of the cylinder B. The admission of gas to the cylinder B is controlled by the valve K; and the piston is operated by the second crank-shaft G, which is driven by the gearing H I from the main crank-shaft J, to which the rod of the piston A is coupled. Third stroke—This is the working or effective stroke; the charge compressed during the latter part of the second stroke being ignited, and the piston A thereby impelled outward. Fourth stroke—The products of combustion are expelled through the exhaust-valve L, by the in-stroke of the piston A.

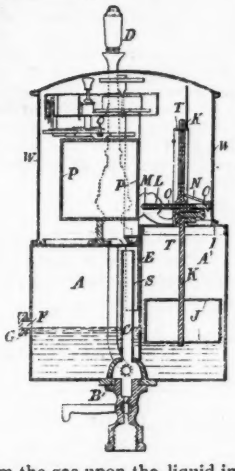
The charge of gas is injected into the cylinder B during the in-stroke of the piston A, as under the second head; while the exhaust and air admission valves are closed, and the valve K is open. The injection is effected by a pump, as shown, or by means of any other suitable appliance, worked by the engine or otherwise, as convenient.

Reciprocating Machinery for Exhausting or Compressing Air, Gas, &c.—Williams, J. N. S., of Glasgow. No. 19,585; Oct 18, 1893.

This invention in reciprocating pumping machinery is designed to obtain "increased economy and efficiency in working, by diminishing the bad effects due to re-expansion of the air, vapour, or gas in clearance spaces at the ends of the pump-cylinder." The patentee proposes to employ a special arrangement of positively actuated Corliss oscillating inlet and outlet valves for the pump-cylinder, opened and closed at particular times; and to form shallow grooves in the inner sides of the cylinder at each end, through which part of the entrapped air passes to the other side of the piston. This allows the suction to act fully as the piston moves away from the end; while the air passing through the grooves supplements the air on the other side of the piston and about to be compressed.

Automatically Registering the Pressure of Gas.—Coe, F., and Harrison, R. J., of Derby. No. 21,048; Nov. 6, 1893.

This portable pressure gauge and register consists of a vessel, divided internally into compartments A A^1, and having a socket or female screw B on the underside, so as to fit on the service-pipe. From this joint there pass three tubes—two of which communicate with, and supply gas to, the governors and burners D; while the third (C) supplies gas to the pressure-gauge. The division E between the two compartments is securely fixed at the top of the receptacle; the joint here and at the sides being water and gas tight. The bottom of the division is kept (say) ½ inch therefrom, to permit the water or other liquid to flow backwards and forwards, according to the pressure of the gas, as hereafter explained. The compartment A^1 is provided with a loose cover or lid I. Water or petroleum, or other suitable liquid, is poured into the vessel A^1, until it reaches the level of the outlet F. It is then closed with a cap G; an opening H, communicating with the opposite part of the vessel, being provided for pouring in the liquid. The tube C is carried above the level of the liquid in A; the pressure of the gas forcing the water in the other compartment A^1 to take a higher level, and carry with it a float J. This latter carries a rod K, working in suitable bearings; and upon the rod is a transverse cylinder or tube L, in which is placed a pencil M, kept (by an elastic band or spring N and a piston O) normally pressed up to a drum P, upon which are fixed papers divided round the periphery of the drum into hours and parts, and vertically into inches and decimals. The drum P is caused to revolve slowly; being geared to the hour-wheel of clockwork mechanism Q.



As the pressure from the gas upon the liquid in A is greater or less, the pencil attached to the vertical rod of the float will mark upon the paper on the drum P the variations of the pressure during any given time; the position of the pencil being adjusted to mark zero, or any starting point, upon the registering paper when the liquid is at its normal level—that is to say, when there is no pressure of gas upon it, and when it is level with the overflow.

The clockwork mechanism is carried upon framework fixed to vertical pillars or columns R, fitting into recesses S, prepared for same in the vessel A; the pillars or columns carrying also a light framework T, through which passes the guide-rod K. To the guide-rod are fixed arms U, carrying rollers V, which bear upon the sides of the standards of the framework T, so as to steady the action of the float and pencil, and avoid friction.

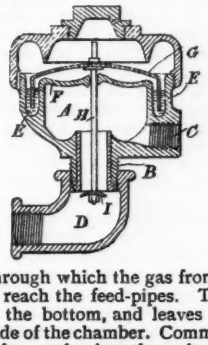
The details of the framework may be varied according to circumstances; but the apparatus described and illustrated is specially designed for use in street-lamps. The parts, therefore, are kept as small as is compatible with efficient working. It will, however, be readily understood that the invention may be applied for testing and registering the pressure of gas; and it will also be found useful as a "tell-tale," for indicating the time that lamps are extinguished—the float then falling, and the pencil dropping down to zero on the registering paper.

Gas-Heated Ovens.—Olsen, J. L. W., of Copenhagen. No. 21,155; Nov. 7, 1893.

This invention relates to improvements in patent No. 9625, of 1891. The apparatus there described has the disadvantage, says the inventor, that fresh air is not conducted in the proper way and in sufficient quantity to the gas-flame. In the present invention, therefore, it is arranged that the gas-channel is combined with air-channels above and below; the ends of the channels having their tops and bottoms tapered toward each other, and the sides flared or curved outward. In this way, the air is conducted directly to the points of combustion of the gas, so that the flame cannot turn backward (as heretofore) on account of not having a sufficient supply of air; but, on the contrary, on account of a sufficient air supply at all times, it passes through the oven.

Gas-Governors.—Boult, A. J.; communicated from A. Ford, of Oakland, California. No. 21,318; Nov. 9, 1893.

This invention has for its main object to prevent the escape from gas-governors of the sealing-fluid in which the valve-controlling float is immersed.



A is the chamber through which the gas from the mains has to pass before it is allowed to reach the feed-pipes. The gas enters through a tubular inlet B at the bottom, and leaves through an outlet C of similar shape at the side of the chamber. Communication is established between the inlet and the supply pipes through an L-coupling D. Close to the outlet, and communicating with it, is an annular depression

formed in the bottom of the casing around the inlet B, and adapted to collect any sediment resulting from the gas. E is a trough formed annularly between concentric walls, and running upwardly from the lower part of the casing. Into it is poured the sealing-fluid—quicksilver preferred. F is a horizontal partition, which covers the empty space in the casing surrounded by the inner wall of the trough. It is downwardly-curved, forming, on the top of the gas-chamber, a circular depression confined between two ridges, one of which is at the inner edge of the trough E, and the other in a higher plane around the central opening provided for the valve-stem hereafter mentioned. The depression within the ridge affords a convenient means of collecting the quicksilver which may be accidentally thrown over the inner edge of the trough, while the higher innermost ridge effectively prevents its escape into the gas-chamber, and thence into the pipes and meter. Above the diaphragm is the float G, which consists of an inverted cup, having a slightly curved bottom, and whose edges dip in the sealing-fluid contained in the trough. To the centre of this cup is secured a spindle or stem H, which runs vertically through the gas-chamber, passing through the opening and inlet B, and carrying the gas-regulating valve I at its lower end. The upper end of the stem also projects in a vertical direction above the float, where it may be used to hold weights occasionally placed around it to regulate the pressure at which the float shall rise. The valve I is placed so as to be easily accessible at the bottom end of the inlet B, which it closes and uncloses according to the pressure.

APPLICATIONS FOR LETTERS PATENT.

24,826.—BLUM, J., "Conversion of carbonaceous matter into permanent gas, practically free from nitrogen, for heating and illuminating purposes." Dec. 27.

24,909.—LAKE, H. H., "Regenerative burners." A communication from T. Gordon and W. R. Swift. Dec. 27.

25,101.—LACKERSTEEN, J. F., "Gas and oil engines." Dec. 30.

The Water Supply of Stainland.—The new water supply for the inhabitants of Stainland and Old Lindley was turned into the mains on Saturday, the 30th ult.; and the Huddersfield supply, which up till now has been used, was shut off. The people of the district are therefore now receiving a supply from their own works.

Salt Lake and Ogden Gas and Electric Light Company, Limited.—Interest was paid on the bonds of this Company on the 1st inst.; and it is stated that a dividend will shortly be declared upon the ordinary shares. The Company, it may be remembered, was organized early last summer to take over the gas and electric light works of the cities of Salt Lake and Ogden, in Utah.

The Barry and Cadoxton Local Board and the Gas-Works.—Under the powers of the Act passed last session, the Barry and Cadoxton Local Board may now become possessed of the gas and water works. By consent the purchase-money has been fixed at £149,000; and it is provided that the sum of £3000 shall be distributed between the Directors and their Solicitor, while the debenture stock of the Company, amounting to £17,000, must be regarded as a first charge on the property, and a charge on the district fund and general district rate. Provision is made to enable the Local Board to borrow the amount of such expenses as have been and may be incurred in the municipalization of these undertakings; the prescribed periods being 40 years for the repayment of the loan for the gas-works, 50 for the water undertaking, and 10 for the defrayment of the costs and expenses attendant on the promotion of the Act. Stock-taking on the Company's premises has almost been completed; and it is not improbable that the Board will determine during the present month what amount of money shall be borrowed, and the purchase may be soon completed. The Clerk to the Board (Mr. J. A. Hughes) states that, as the present plant was laid down for a much larger town, there would be no expense incurred in this direction for a long time. It was, he says, not owing to either poorness in the quality of the gas or insufficiency in quantity that the Board sought powers to purchase, but because they felt that, if bought now, the undertakings could be obtained at a fair price, which would prove remunerative to the community.

Wolverhampton Electric Light Scheme.—Last Thursday, Mr. Codrington, one of the Local Government Board Inspectors, held an inquiry, at Wolverhampton, relative to an application by the Corporation for a loan of £30,000, for the purpose of carrying out the electric lighting scheme for the borough. The Town Clerk explained that the Provisional Order under which the Corporation sought to supply the electric light for public and private purposes was granted in 1890. Consent had already been obtained to a loan for the purchase of the necessary land. A generating station was about to be erected, at an estimated cost of £4985, according to an accepted tender. The Electrical Engineer to the Corporation (Mr. F. H. Lewis) had had considerable experience; and the Corporation had every confidence in the scheme he had submitted. The central station would be at the Town Hall, with branch stations at the Art Gallery and the Free Library. It was proposed to light the streets by means of arc lamps. There would be 42 lamps, and 20 of them would be extinguished at twelve o'clock at night, and the others would be left till a later hour. The estimated cost of the scheme was £30,000, of which £17,442 was for plant, £1320 for arc lamps, and £2243 would be left for contingencies. With regard to the question of the repayment of the loan, he had written to the Local Government Board, asking whether they had any powers to suspend the operation of the sinking fund with respect to this undertaking for a few years, in order to enable the Corporation to turn round during the time between the commencement of the work and the completion of it. It was not to be supposed that the Corporation would make immediate profit. The Electrical Engineer estimated the total annual expenditure at £3307; and to cover this a minimum annual consumption would be required of 193,600 units, at 6d. per unit, which was equivalent to the consumption of 530 8-candle power lamps and 50 arc lamps. Evidence was given by Mr. Lewis and other officials; and there was no opposition.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by correspondents.*]

The Peebles Oil-Gas Process and the Huddersfield Oxy-Oil Plant.

SIR,—I quite expected that Mr. Herring, as one of those interested in the operations at Huddersfield, and who had visited this district and inspected the Peebles process in operation, would take up the position he does. Had, however, Mr. Herring sent you the whole correspondence which passed between us subsequent to his visit to inspect the Peebles process at the works here, instead of his single letter to me of the 16th of March last, your readers would have seen how ready I was to respond in a friendly way, and to follow the course he now suggests—of visiting his works, and satisfying myself upon the matter.

I now herewith send you copies of that correspondence, and have only to remark that I expected Mr. Herring to let me know when he was in a position to show me his plant in operation. The only intimation I have had was through his letter appearing in your columns.

The gentlemen who made the communication regarding the similarity between the process of cracking-up the oil at Huddersfield and the Peebles process, were no personal friends of mine; they were gentlemen interesting themselves in oil-gas processes, and perfectly competent to form an opinion on the subject. They, however, took rather a broader view of the Peebles process than does Mr. Herring. Mr. Herring is evidently desirous of limiting the Peebles process of cracking-up oil into gas and coke to the use of plant substantially identical to that which he saw employed to carry out the process at Peebles. The process patented by Mr. Bell and myself makes no claim for the use of any particular form of plant, but is for the method adopted of decomposing the oils, one of the novel features of which is doing what Dr. Thorne in his paper says they are doing at Huddersfield—viz., subjecting the oils to repeated crackings at a low temperature by purposely running the oil into the retort in a fairly large stream, so that the major part will leave the retort ungasified—the ungasified portion being condensed, and again and again returned to the retort, always in a fairly large stream, until the whole of it is reduced to gas and coke.

That is the part of the Peebles process which I maintain is embodied in the process as worked at Huddersfield, and which, so far as I am aware, had never been done prior to the advent of the Peebles process. I now ask Mr. Herring, as I previously asked Dr. Thorne, to refer us to any practical oil-gas process, other than the Peebles process, where the oils were purposely run into the retort in a fairly large stream, with the object of cracking-up the oil in that fractional manner.

Mr. Herring appears to be under the impression that, by differentiating the plant from that which he saw at Peebles—to the extent of running the fresh oil into one set of retorts, heated to a low temperature, in a fairly large stream, and cracking-up the partially decomposed oil so obtained, by running it into a second set of retorts again and again, purposely, in a fairly large stream, till the whole is cracked-up into gas and coke, instead of doing the respective cracking all in one retort, as at Peebles—he will thereby be outside the patent. That may be Mr. Herring's opinion; it certainly was not the opinion of the gentlemen connected with the gas industry who had seen both the Huddersfield and the Peebles process.

Anyone—even with a very rudimentary knowledge of the manufacture of oil-gas—when put in possession of the great advantages arising from fractionally cracking-up the oil in the manner described and shown to them at Peebles, would at once see that there are many modified forms of plant by which the process can be carried into effect. Indeed, in the considerable number of works now using the Peebles process, there are not two plants identically alike; and in more than one works, the major part of the oils is fed direct to the retorts—the same as at Huddersfield, only the small quantity of oil required for working the gas flowing back, and commingling with the partially decomposed oils before flowing into the retorts.

That the Oxy-Oil Proprietary Company and Mr. Herring have been working upon similar lines to Mr. Bell and myself, I have no desire to deny. I have, however, taken what steps I thought desirable to get all the information that could be honourably obtained regarding the lines on which they were experimenting prior to the visit of those interested in the operations at Huddersfield to inspect the Peebles process; and I think I am justified in saying that I have failed to get any evidence, other than Mr. Herring's statements, that, prior to the advent of the Peebles process, they had been working upon the lines of the present Huddersfield process.

I am, however, still open to conviction, and will be pleased if Mr. Herring can supply us with such evidence as would enable me to act in the spirit indicated in my letter to him of the 17th of March last.

Priorsford, Peebles, Jan. 4, 1894. WM. YOUNG.

[ENCLOSURES.]

Priorsford, Peebles, March 17, 1893.

W. RALPH HERRING, Esq., Corporation Gas-Works, Huddersfield.

Dear Sir,—I have your letter of yesterday. I assure you I was very sorry indeed that I was unable to have the pleasure of meeting you when here on Monday, as I would have liked very much to have had a chat with you regarding the subject of your letter.

It is not the first time I have found myself developing improved processes on parallel lines with others. I have, however, rarely experienced much difficulty in coming to an amicable understanding with *bonâ fide* fellow-workers; and I heartily join you in trusting that no misunderstanding will arise in our case.

I understand from Mr. Bell that you expressed yourself agreeable that we should see what you are doing at Huddersfield; and if nothing comes in the way, we propose visiting you next week—leaving here Thursday morning, but will wire you before leaving.

Trusting it will be convenient for us to visit you then,

I am, yours truly,

(Signed) WM. YOUNG.

Corporation Gas-Works, Huddersfield, March 20, 1893.

WM. YOUNG, Esq., Priorsford, Peebles.

Dear Sir,—I am in receipt of your letter of the 17th inst., and shall be

pleased to meet Mr. Bell and yourself here at the time you name, although I think it only right to let you know that we are not in a very forward state with our plant, as, owing to it being impossible to complete the oxygen plant before next month, we have not hurried forward with the work in connection with the oxy-oil plant. But, as stated in my letter to you, the arrangements were completed, and most of the material ordered, last autumn.

If you were to defer your visit for a month, I should then have something of a workable nature to show you, whereas now I am afraid it would not be worth your while coming. I shall, however, be pleased to see you.

Yours truly,
(Signed) W. R. HERRING.

Priorsford, Peebles, March 22, 1893.

W. RALPH HERRING, Esq., Corporation Gas-Works, Huddersfield.

Dear Sir,—I have your letter of the 20th inst. As it will be a month yet before your plant is working, we will defer our visit till then.

Thanking you for your invitation,

I am, yours truly,
(Signed) WM. YOUNG.

Philology and Gas Apparatus.

SIR,—With every respect for the opinions expressed in your editorial remarks on the above subject in the JOURNAL for the 26th ult., I fail to see why new appliances and adaptations should be saddled with a name or title which has an old and specific meaning, which does not apply to the apparatus referred to. The word "stove," in its original meaning, refers to a heated chamber; and its application, in some newer dictionaries, to a hothouse for plants, still retains the same meaning. The appliances for the use of gas as a fuel have, without exception, clear and descriptive names that cannot be misunderstood; and there is no reason why the correct names should not be used. I do not take up this subject as a Professor of the English Language; being too fully aware of my own shortcomings in this respect, and of the difficulty I have in expressing my own meaning in suitable language. My only object is to try to stop a growing trouble, and a source of error and unnecessary correspondence.

Another error, which is fortunately dying a natural death, is the use of the word "*déposé*." The individual who introduced this word evidently did not understand that it simply means "registered"—*i.e.*, a registered design; and, no doubt thinking that a French word sounded well, he called his boiling-burners "*Déposé* Stoves," in spite of the fact that the designs were not registered, and that the boiling-burners were not "stoves" in any sense.

I may add, with regard to my article on "The Use of Coal Gas for Domestic Purposes other than Lighting," reprinted from *Hygiene* in the last issue of the JOURNAL, that it should be borne in mind that it was written from a medical standpoint for a medical publication, and, of course, contains many simple elementary facts which are, to a certain extent, out of place in a technical paper.

THOS. FLETCHER.

Warrington, Jan. 2, 1894.

Extensions at the Colne Gas-Works.—At the monthly meeting of the Colne Local Board last Wednesday, it was decided to apply to the Local Government Board for sanction to borrow £10,000 for the purpose of erecting a new gasholder, building a workshop and governor-house, and carrying out other improvements.

The Cost of Lighting Paris.—According to the estimates just published, the cost of lighting Paris during the current year will be as follows: Price of gas, 4,075,511 frs.; maintenance of gas apparatus, lamps, &c., 1,166,400 frs.; lighting the markets, abattoirs, &c., 101,500 frs.; for oil and the maintenance of oil lighting apparatus, 70,400 frs.; electric lighting of streets, 507,453 frs.; electric lighting in markets, abattoirs, and other places appertaining to the Municipality, 587,000 frs.; maintenance of the municipal electric lighting station at the Halles Centrales, 456,400 frs., or in all about 7,000,000 frs.

The Electric Lighting Installation for Newport.—Colonel Ord Hasted held an inquiry at Newport last Wednesday into an application by the Corporation for the sanction of the Local Government Board to the borrowing of £28,000 for electric lighting purposes. It was stated that the scheme which it was intended to carry out had been propounded by Mr. Robert Hammond. The central station would be erected on land in the possession of the Corporation, which was valued at £2561. The plant would be equal to 7500 incandescent lamps burning simultaneously, but double that number could be fixed; while the arc plant would be capable of supplying 150 lights. It was further mentioned, as to the prospects of the electric light, that the Corporation were very large consumers of gas in the different public buildings, and also in regard to the street lighting, which was done by 800 public lamps. It was not proposed, at the outset, to light more than 40 arc lamps in the main thoroughfares; but, apart from the use of electricity for lighting the streets, it was anticipated that the whole supply proposed to be given would be taken up by private consumers. The Inspector visited the site of the station, where details were gone into.

The Public Lighting of Wednesbury.—It was reported by the Gas and Water Committee, at the meeting of the Wednesbury Town Council yesterday week, that they had received an intimation from the Birmingham Corporation that the charge for public lighting in the borough would for the future be 1s. 2½d. per 1000 cubic feet; being an increase of 1½d. Mr. Griffiths, in submitting the report for adoption, said the original charge was 1s. per 1000 feet. Then there was an advance of 1d., and now one of 1½d.; making 2½d. in all. Mr. Joynson asked if this would not be a favourable time to inquire as to the quality of the gas supplied to the town; and Mr. Oldbury referred to the propriety of lighting the public buildings by electricity. Mr. Griffiths, in reply, said the question of the quality of the gas was under the consideration of the Gas Committee. As to electric lighting, a great outlay would be incurred in providing the apparatus; but, if it were the wish of the Council, an installation could, of course, be carried out. The Mayor (Mr. W. H. Lloyd) remarked that a plan had been perfected of putting oxygen into gas, whereby the lighting power of the latter was considerably increased; and, if this could be generally done, the desire for the introduction of electricity would become less prominent. The report was adopted.

MISCELLANEOUS NEWS.

METROPOLIS GAS SUPPLY.

The Movement in the Direction of Cheaper Gas.

In another part of the JOURNAL, reference is made to the petition presented to the House of Commons by the Vestry of St. Luke's, Middlesex, praying for an inquiry into the present management and working of the Metropolitan Gas Companies. This sets forth that the parish under the authority of the petitioners comprises an area of about 220 acres, contains a population of about 42,500 persons, and property of a rateable value exceeding £325,000, and lies within the area of The Gaslight and Coke Company. It further states that large sums are paid to the Company by the petitioners, in their capacity as the Local Authority as well as in their private capacity, for gas supplied to the public lamps and the Vestry Hall and offices. Reference is next made to the provisions contained in the Acts of the Metropolitan Gas Companies for regulating the price and dividends in accordance with a sliding-scale; and it is then stated that the price charged by the above-named Company for gas supplied to the public lamps in the petitioners' parish is 2s. 2d. per 1000 cubic feet, and to their various establishments 3s. 1d. per 1000 cubic feet, exclusive of the meter-rent. Belief is expressed by the petitioners that similar charges are made to the several lighting authorities and private consumers by the Company throughout their area of supply, except as specified below. They then go on to say: "Your petitioners learn that the charge made by The Gaslight and Coke Company to private consumers in that portion of their area of supply which is situate south of the Thames is 2s. 5d. per 1000 cubic feet only; while in that portion of their area of supply which is situate within the City of London, no charge whatever for meter-rent is made to customers. Your petitioners are of opinion that the time has arrived when the existing anomalies in the charges for gas supplied and use of meters by The Gaslight and Coke Company should be removed, and that all gas supplied by the Company to private consumers should be sold at a uniform charge, with the free use of meters; such charge not exceeding the lowest rate charged by any other of the Companies supplying gas to the Metropolis. Your petitioners believe that the object of Parliament in fixing the standard price and statutory limit of dividend authorized to be paid by the several Gas Companies was to encourage the development, in the public interest, of the gas industry, and at the same time to provide a fair remuneration to those persons who had embarked their capital in the undertakings, but were not at the time, or had not previously been, in receipt of a reasonable return upon their outlay; but your petitioners believe it was not the intention of Parliament to fix the rate of charge for gas supplied and the limit of dividends for all time, but that the standard price and rate of dividend so authorized were intended to be of a temporary character only. Your petitioners are of opinion that a sufficient time has now elapsed, during which the statutory dividend authorized has been paid by the several Metropolitan Gas Companies, as amply to compensate those interested in the gas undertakings for the loss of income sustained during the time the capital expended was unremunerative; and that, in justice to the consumers of gas within the Administrative County, the provisions of the Acts fixing the price of gas supplied and the rate of dividend should be reconsidered." The petitioners therefore ask the House to direct an inquiry into the present management and the working of the various Gas Companies of the Metropolis, and as to their existing statutory rights, and the past results—financial and general—of the statutory sliding-scale of price and dividend, with the object of a Bill being subsequently introduced to provide for reducing the standard price and statutory limit of dividend now authorized to be charged and paid by the Companies, and for a uniform charge throughout the Metropolis for all gas supplied, to include the free use of meters.

MANCHESTER CORPORATION GAS SUPPLY.

The Gas Committee and Mr. Southern's Recent Memorandum.

At the last Meeting of the Manchester Corporation Gas Committee, the Chairman (Mr. J. Brooks) called attention to the course pursued by Mr. J. W. Southern, in issuing to the members of the Council and to the public, through the press, a pamphlet on the working of the Manchester Gas-Works, reflecting upon the purchasing of material, the manufacture of gas, and generally on the administration of the Gas Department. It was resolved—"That, while the Gas Committee are prepared, at the proper time, to submit an answer to the charges made by Councillor J. W. Southern, they respectfully request that he will at once formulate the resolution which he proposes to lay before the City Council." It was further decided to send a copy of the resolution to Mr. Southern. The subject was referred to at the meeting of the City Council last Wednesday, under the presidency of the Lord Mayor (Alderman Anthony Marshall). Mr. Brooks said he thought it was only fair and just to the Committee that the resolution with which Mr. Southern threatened them should be immediately brought forward. He expected that it would be moved that day; and he was disappointed that this course had not been pursued. Until it was moved, the mouths of the Committee were entirely closed; and as they had not the opportunity of replying to the allegations made, the matter ought not to be delayed. Mr. Southern replied that he had published, from authentic and authoritative documents, certain facts and figures relating to the manufacture of gas in the city. His object was not to censure the Gas Committee. He wished to see their great gas undertaking producing better results for Manchester; and he did not desire to make any personal or acrimonious attack upon any individual. The present Chairman and Deputy-Chairman of the Committee had not been long in their positions; and he did not want to fix responsibility for the present state of things on them, or on any individual. He had said in his pamphlet that, upon a suitable occasion, he should move a resolution in the Council based upon the facts and figures he had produced. If there was any person who could controvert or correct

those figures, or draw a different inference from them, he should be very pleased to hear him. All he desired was that they should arrive at a judicial and impartial conclusion. It was not his intention to bring forward his resolution that morning, because the *agenda* paper was rather full; and he did not wish to have the matter discussed at the end of a long sitting. Alderman Rushworth said he thought Mr. Southern had said too much or too little. They ought not to allow the Gas Committee to remain under the stigma of the charges which had been made; and Mr. Southern should move his resolution. Mr. Southern undertook to do this at a special meeting, or, if he could secure a convenient place upon the *agenda*, at the next meeting of the Council. The subject then dropped.

Writing on the above subject, our Manchester Correspondent says: It is impossible to read the report of what transpired at the meeting of the Manchester City Council last Wednesday without coming to the conclusion that Mr. Southern is himself a little afraid of the bogey which he has created. In his "Memorandum" of a month ago, he referred to "the unsatisfactory position of the gas undertaking, as judged by the result of its working in comparison with other large towns," called attention to the manner in which certain advantages which the Manchester undertaking possesses in the matter of capital are "frittered away," and urged the Gas Committee to take steps to "place Manchester where it ought to be—in the foremost place, and not, as it now is, in the hindmost, in this most important department of Corporation enterprise." Mr. Southern, moreover, has directly challenged contradiction of his statistics, which he declares "are authentic and may be considered reliable." The "Memorandum" was, in a word, put forward with such an air of confidence that one really hoped Mr. Southern meant business, and that the outcome of his movement would be some suggestion for placing the undertaking in the position which it ought to, but does not, occupy. But on Wednesday this champion of reform adopted another and quite a different tone. Urged by the Gas Committee and their Chairman to bring forward his threatened resolution without delay, he assumed an apologetic and deprecatory attitude; and contrived, while promising to move in the matter at the next meeting, to leave the impression that he was by no means so earnest or anxious in the matter as his original pronouncement led one to believe. There is no reason why Mr. Southern or anyone else should make a personal or acrimonious attack upon any individuals; and the resolution to be brought forward need not perhaps be construed into a vote of want of confidence in the Gas Committee. But, on the other hand, there can surely be no reason for protesting so much. If the condition of things is as Mr. Southern alleges, the Gas Committee cannot be absolved from responsibility. As I understand his case, it is that a mistaken policy—a policy of parsimony in the wrong direction—has deprived the undertaking of that continuous and consistent management which is only to be obtained from the direct oversight and supervision of one responsible chief. It is only a couple of months since Mr. Southern expressed the opinion at a public meeting that the appointment of a man with a sound scientific knowledge at £1000 a year would save the ratepayers £20,000 a year. This may or may not be an exaggerated way of looking at the matter; but if it is only partly true, the Gas Committee must bear the responsibility to that extent. It may be the fault of the ignorant and unreasoning pressure which is put upon them from outside; but there is no denying the fact that of late the Manchester Corporation have displayed a tendency to resent the payment of such salaries as will attract to their service the best men for the control of their important spending and producing departments. It is not necessary to argue that this is wrongly directed economy; and it is surely absurd for Mr. Southern to adopt a tone of apology in such a case.

THE LARGE MUNICIPAL UNDERTAKINGS OF MANCHESTER.

In a long article headed "Manchester in 1894," published on the 1st inst., the *Manchester Guardian* gives a considerable amount of interesting information concerning five great municipal schemes, which are either just completed or on the verge of realization, and which involve a total expenditure of nearly 4 millions. Of this amount the Thirlmere water scheme alone, so far as it has gone, claims five-eighths. The drainage system of the city has been remodelled at a cost of £600,000; rather more than £500,000 has been, or will be, spent on extensions in the different gas-works; the electric light installation is responsible for an expenditure which will soon reach £150,000; and the project of supplying hydraulic power to firms within the city means an outlay of £100,000.

Of the above undertakings, that which relates to the water supply is of pre-eminent importance; and the writer of the article deals with it as follows: Within the next six months, the water supply will have been placed on an inexhaustible basis. As the community has grown, we have had to go farther and farther afield to secure an ample provision of this prime necessity of life; but we may now rest assured that our foraging days are done. Three hundred years ago, Manchester had no occasion to stir abroad for water. The inhabitants derived their chief supply from a well in Fountain Street; and our ancestors filled their pails at a public conduit, the site of which is now covered by the Royal Exchange. The conduit was fed by stone pipes from Fountain Street, from the Shudehill pits, and from the ponds near the site of the present Royal Infirmary. At a later period, the town brought its water from Gorton and from the canal at Peak Forest, supplementing the supply with water pumped from the unpolluted Medlock. Eventually the Corporation seized upon Longdendale, dammed up the River Etherow into reservoirs, submerged a village or two, and rested. In 1855 Manchester and the district were satisfied with 8 million gallons per day. With a population of a million within the area of supply, we now require a daily delivery of 24 million gallons. Longdendale has never failed us, so long as there has been an average rainfall; but in periods of drought, the city has again and again been thrown into a state of mild panic at the prospect of a water famine. Thirlmere will save us from all such apprehensions in future. The proud place which the district holds in the rainfall returns commends it to the water-works engineer, if not to the tourist. At Longdendale the average yearly rainfall is a mere 50 inches. Thirlmere doubles that quantity, and adds 4 inches to the bargain. There are no springs at Thirlmere as at Longdendale. They will never be missed. The moment the water comes down, it rushes along the hard, impervious rock straight into the reservoir. When the lake is full to the level to which it is being raised by an embankment now almost completed, we shall be able to rely upon Thirlmere for a supply of 50 million gallons per day for 150 days, even in periods of the greatest drought. The great aqueduct by which this volume of water will be carried through hill and over dale for a distance of 95 miles is finished. It is the longest channel of the kind that the world has ever seen. The greatest of the Roman aqueducts—the Anio Novus—which was constructed in the time of Claudius, was only 62 miles long; but it held the "record" until Liverpool went to the Vyrnwy and brought water from Wales through tunnels, pipes, and syphons over a distance of 75 miles. Manchester has now beaten both Rome and Liverpool. Generations hence the Thirlmere aqueduct will perhaps have its full complement of five iron conduits, each capable of conveying 10 million gallons per day; but at present only one of those pipes has been laid down, and the necessity of a second is not likely to be realized for twenty years. The aqueduct commences at the south-east corner of the lake, and at such a level that the surface of the water running into it at the entrance will be about 531 feet above Ordnance datum. The water will be delivered into the Prestwich service reservoir at a height of 353 feet, and will therefore have a fall in the length of 178 feet. In the first 22 miles of the aqueduct, there are seventeen tunnels, having an aggregate length of 14,000 yards, and seven syphons, with an aggregate length of 9000 yards; the remaining 15,700 yards consisting of cut-and-cover. The greatest length of a single tunnel is 5225 yards; and the greatest depth, 660 feet. Progress at Thirlmere has been somewhat retarded owing to an engineering difficulty which arose some time ago in the construction of the embankment at the northern extremity of the lake. A fault in the rock necessitated the excavation of 11,000 cubic yards of stone out of a narrow gorge, which had afterwards to be filled in with an equal proportion of concrete, in order that the engineer might go 50 feet lower than was originally intended for a secure foundation. Should the winter continue favourable, we may expect to see the work so far completed as to put us in possession of a daily supply of 10 million gallons in the course of the next few months. The scheme will then be about fifteen years old, for although the works were not commenced till 1885, the Act of Parliament was passed as long ago as 1879; and it will then have cost about £2,500,000. Each additional 10 million gallons per day will entail a further expenditure of £500,000; so that the cost of the scheme when it is actually finished at some far distant date will have reached a total of about £4,500,000.

The succeeding section of the article is devoted to the hydraulic power installation, which will be placed at the service of the citizens on the 1st prox. The engine station is nearly completed; and most of the piping has been laid down in the area of supply. About 1000 lbs. pressure to the square inch will be obtained at the central station; and this force will be tripled by intensifiers placed in the premises of customers. The Hydraulic Power Committee are in possession of land sufficient to enable them, when necessary, to build two more stations; and they have already decided to extend the original scheme, under which about ten miles of piping have been laid. The water supplied under hydraulic pressure will be taken from the city mains.

Brief mention is next made of the electric lighting scheme; and, according to the writer, the number of applications for a supply of the light has been so enormous that the Committee will probably have to extend their plant in the course of the winter. The original capital of £100,000 which was devoted to the scheme has been drawn on to the extent of £70,000; but it is the intention of the Corporation to set aside an additional sum to be applied to the further development of the enterprise. The installation has been in full use since last September. In July a temporary two-wire arrangement was brought into operation from the station in Dickinson Street, and had continued for about three months, when, by a remarkable feat in electrical engineering, it was replaced within the space of a few hours by the five-wire system, which will now continue in permanent use.

In regard to the gas supply, some definite information is given as to its extension; and this portion of the article reads as follows: Electricity is not going quite to kill gas as a means of illumination in the city. At present our gas supply cannot be said to give universal satisfaction. A prominent city councillor was unkind enough the other day to suggest an uncomplimentary comparison between the gas management of Manchester and that of Salford; his comprehensive conclusion to a lengthy indictment being that "Manchester is in the hindmost place in this most important department of Corporation enterprise."* Those who think with Mr. Southern will be relieved to learn that the Gas Committee are not inactive. The Corporation obtained power during last year to borrow £500,000 for gas-works purposes; and the money is being spent. At the Bradford Road works, the manufacturing and purifying plant has been practically doubled during the last eighteen months. The storeage capacity is equal to 6,000,000 cubic feet of gas at present; but a new holder is in course of erection which will store 7,000,000 cubic feet. Stoking machinery on the West pneumatic principle has also been introduced, and is working most satisfactorily. At Rochdale Road the efficiency of production has been improved by the reconstruction of the retorts in one house; and at Gaythorn a new gasholder to contain about 1,500,000 cubic feet of gas would have been quite complete by this time had it not been for a slight leakage of water which has had to be remedied. A holder to contain 525,000 cubic feet has been erected at Droylsden, where new retorts on the inclined principle are now in satisfactory operation. Altogether the storeage capacity will be increased during this year from its present limit of 18,000,000 cubic feet to 25,000,000 cubic feet. Including the works mentioned, it is proposed during the next eight or ten years to expend on the Bradford Road works £135,000; on Gaythorn, £35,000; on Rochdale Road, £50,000; on Droylsden, £17,000; on street-mains,

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* See JOURNAL, Vol. LXII., p. 1092.

£200,000, at the rate of £20,000 a year for ten years; on meters and stoves, £50,000; and on miscellaneous works, £15,000—bringing the total up to £502,000. These are figures suggestive of enterprise, if not of severe economy; and they represent an extraordinary growth in the manufacture and distribution of gas in the city. From the very inception of the process, however, Manchester has taken a prominent part in its development. Salford, significantly enough (as Mr. Southern might say), was first in the field. It was in 1805 that the first building in the borough was lighted with gas; but only two years later, the Police Commissioners of Manchester "boldly" affixed a public lamp opposite their premises in Police Street. In 1824 Manchester found itself in the position of being the first municipal authority to obtain powers for the manufacture and supply of gas—an enterprise which now yields a yearly revenue to the Corporation of more than half a million.

Finally, the great scheme of main drainage is lightly dealt with. Eventually, the whole drainage of the city will be directed, by gravitation, to the outfall works at Davyhulme. Originally the cost of this undertaking was estimated at £500,000; but the addition of several townships to the city has extended the field of operation, and increased the cost by about £100,000.

MUNICIPAL WORK IN DUBLIN.

Water Supply and Gas and Electric Lighting Questions.

On the 1st inst., Alderman V. B. Dillon was installed in the high office of Chief Magistrate of the City of Dublin. It will be remembered that the new Lord Mayor has figured somewhat conspicuously in the numerous discussions which have taken place in the Municipal Council on questions affecting the Gas Company; and to these and other matters of interest to our readers he referred in the course of his speech in thanking the members for the honour bestowed upon him. Among the Committees whose work came under review were the Paving and Lighting Committee, the Special Gas Committee, the Water Committee, and the Electric Lighting Committee. Adverting first to financial matters, he said the total amount of loans taken up since Dec. 31, 1888, for municipal purposes was £191,259. In the class of reproductive works, he found they had spent on the gas-meter testing-station £2500; and on electric lighting buildings and machinery, £37,000. Among the permanent works, they had expended £14,341 on the public lighting plant, which would effect a saving. Provision was made in the estimate for 1894 for taking up, in the reproductive loans, £24,000 for electric lighting; and for water-works purposes: Eighth Lock, Grand Canal, £8500; for pumping for Avonmore works (this he trusted would not be required), £2000; Royal Canal works, £6500; and they proposed expending on a second line of pipes and aqueduct, £61,000. In the class of permanent works, they would require £500 for the gas-meter testing-station. Leaving the subject of finances, he alluded at some length to the public health, intimately associated with which was the question of the water supply. In this connection, referring to the later prolonged drought, he said that the reservoir at Vartry commenced to fall on March 14; and it continued steadily to drop until Nov. 17. The contents of the reservoir on March 14 were 2400 million gallons; they fell on Nov. 16 to between 75 and 76 million gallons; and it contained now 600 million gallons—in other words, it was only one-quarter full. Now, while they had recovered very considerably, uneasiness was not altogether removed from the mind of their Engineer (Mr. Harty). He had never seen a man, in his experience of the world, subject to such a strain as Mr. Harty had been; and he had never seen a man approach the subject and keep his head so level as Mr. Harty did during all this exceptional period. Their anxiety was not altogether removed, because if the reservoir did not fill before the dry weather came again, they might have a recurrence of drought. Therefore they were still using the Grand Canal water for the south side of the city; but they had been able to supply Vartry water to the consumers in the townships and a large part of the city on the south side to which the canal water would not reach. In connection with the supply of water from the River Dargle, he thought the Council were deeply indebted to Lords Monck and Powerscourt for the readiness with which they placed that supply at the disposal of the citizens, free of charge. He should not omit to state that the citizens should also be grateful to the Commissioners of Rathmines for the readiness with which they offered the supply of water to which they had a right from the Grand Canal Company. To prevent anything like a repetition of such a condition of things, the Committee were promoting this year a scheme for extending the area of supply at the Vartry. That scheme had been provisionally sanctioned by the Council; and certain preliminary steps were now being taken. The Committee would have to report again to the Council; but, in the meantime, they were obtaining the opinion of eminent engineers and analysts as to the feasibility and advisability of the project. Now that the crisis had passed away, the general opinion would not be unfavourable; and he believed it would be considered that they acted wisely in keeping up as they did, owing to the extraordinarily hot weather, a full supply of Vartry water, and supplying it for shorter periods and their using other supplies after the extreme heat had passed away. They were taking care that the reservoirs at Stillorgan should be filled, by constructing a second line of pipes; but this would not produce an additional supply at the catchment area. What he had endeavoured to impress at all times on his fellow-members—and he should continue to do so—was the necessity of increasing the area from which they took their supply. With regard to gas lighting, they had made important changes in the past three years. The public gas-lamps had been purchased; and the testing-station removed and reconstructed. They had endeavoured to procure sufficient testing apparatus, but had not yet succeeded. He trusted this matter would be closely attended to in the coming year. One of the most important duties of the Corporation was, while securing a satisfactory public supply of gas, to ensure a good private supply. It was most unsatisfactory that, while according to the report now before the members, the standard illuminating power was 16 candles, the average of 22 readings taken by the Public Lighting Inspector at the Corporation station in Tara Street in the months of September and October was 15·4 candles. The average of the readings taken the same nights at the public testing-station next door was 16·7 candles. These differences were remarkable, and plainly indicated the necessity for legally determining which authority was correct. It would be the duty of the Corporation to "put the saddle on the right horse" during the coming year. This could not, however, be properly done till the station was completed; but as they had on the *agenda* several entries relating to the matter, he would not further dwell upon it. It was to him a very unpleasant subject, as he was at variance upon it with several friends whose honesty and integrity it would be presumptuous in him to praise. The Corporation alleged that the testing-station was not complete; and this was a subject upon which they would have some discussion in the year. The electric lighting installation had been a great success. The expenditure had been £37,000; and they had supplied 81 arc lamps, and 141 consumers with 14,000 8-candle power incandescent lamps. About 5000 more lamps were required, and 20 arc lamps proposed; and there was a sum of £24,000 more provided for in the estimates this year. They had sufficient revenue from the expenditure to justify them in supplying light to the citizens at a reasonable rate—not quite so cheap as gas, but they trusted that the light was better, more pure, and less injurious to the public health. This was a work of which the Corporation ought to feel proud. They were indebted for it mainly to their colleague Mr. Robinson, who proposed the scheme, and successfully carried it through; and, in this connection, he could not help referring again to Mr. Harty, who brought to the subject an amount of knowledge which he (the Lord Mayor) had no idea he possessed. The work of other Committees was also briefly reviewed.

ROCHDALE CORPORATION GAS AND WATER UNDERTAKINGS.

In its customary annual retrospect, the *Rochdale Observer* refers to the operations of the Corporation Gas and Water Departments during the past twelve months. The work of the Gas Committee, it remarks, has probably attracted more attention this year than in any one of the preceding 48 years during which the concern has been in the possession of the Corporation, not because of any burning question of policy or administration, but for the reason that there was at one time grave doubt as to whether the work could be carried on at all. To maintain an efficient supply of gas for a population of from 70,000 to 80,000 people involves no little care and anxiety in ordinary times and under ordinary conditions; to do it when all the usual sources of coal supply are stopped for a period of sixteen weeks, is a task of great magnitude. The trouble in the coal trade added enormously to the responsibilities of the managers of the department; and it speaks well for the Gas Committee and for their Engineer (Mr. T. B. Ball) that they have been able to overcome the many difficulties inseparable from the prolonged dislocation of their coal supplies with so little inconvenience to their customers. In 1892 the strike in the cotton trade, involving as it did the entire closing of some mills and the working of short time in others, seriously affected the consumption of gas; in the year just ended, the dispute in the coal trade has had a much more disastrous result. The year closes with a decrease in the quantity of gas consumed; but there is a ray of hope in the fact that this diminution is now somewhat less than it was at the close of the coal strike. Perhaps the one especially prominent feature has been the marked development in the use of gas for cooking, heating, and motive power. The actual consumption for these purposes cannot be ascertained definitely; but our contemporary estimates it at double the total output when the works were purchased by the Corporation. There are now about 1400 cooking-ranges alone let out on hire by the Corporation. During the year, a commencement was made with the new works; and the tank for a new gasholder is now fast approaching completion. Parts of the holder itself are already awaiting orders for delivery; and, should the weather prove favourable, the work of erection will be proceeded with at once. The foundations of the new retort-house are being put in; and the Gas Committee have let a contract for a high-level road, which will afford access to the coal-stores from Manchester Road, and also for the necessary boundary walls. With these changes in progress, and (our contemporary hopes) with an ever-increasing demand for gas, the Committee will find themselves amply provided with work in 1894—the jubilee year of this prosperous municipal undertaking. Respecting the Water Department, the work of laying filter-beds at the Spring Mill reservoir has been the most important new undertaking of the Water Committee during the year. Three filter-beds are in course of construction; and there is to be also a pure-water tank to receive the effluent from the filters. Though the progress of the work has not been rapid, it has been steady; and if nothing interferes to prevent a continued advance, the undertaking will be completed early in the spring. It is satisfactory to note that the financial burden which for so many years the water-works have imposed upon the Corporation is still being reduced. Seven or eight years ago, the amount which the Corporation had annually to pay to keep the works going was £16,000 or £17,000. This has now been reduced by more than one-half; and the call on the rates in the next financial year will probably not greatly exceed £7000. Costly as the works have been, there has been no reason to complain of the efficiency of the supply of pure potable water they afford. All through the long summer drought, Rochdale enjoyed immunity from the anxieties which beset towns like Manchester on the score of failing water supply; and on no occasion has it been necessary to restrict the flow through the mains. At the present time the reservoirs are all full.

The Proposed New Water-Works for Mansfield.—The Mansfield Town Council have received a letter from the Local Government Board with reference to their application for sanction to borrow money for commencing the new water-supply scheme. The Board stated that they regretted they would not feel justified in granting a loan for the construction of a reservoir until the preliminary work of boring had further advanced and the yield of water from the proposed source had been definitely ascertained.

ELECTRIC LIGHTING AND WATER GAS AT BELFAST.

At the Monthly Meeting of the Belfast Corporation yesterday week, a motion that new Standing Orders prepared by the Council in Committee should be adopted, caused some discussion on electric lighting. It was originated by Mr. Masterson, who proposed, as an amendment, that the order which provided that "the Electric Committee shall have charge of the superintendence and management of the electric works" should be omitted entirely, and that the words "and the electric works" should be added to the one referring to the Gas Committee; making it read: "The Gas Committee shall have charge of the superintendence and management of the gas-works and gas offices, and the electric works." He spoke of the good work which had been done by the latter Committee, and remarked that it would be a mistake to have two Lighting Committees for the city. Alderman Connor, the Chairman of the Gas Committee, in seconding the amendment, disclaimed on his own behalf, and on behalf of the Gas Commitee, any hostility towards the electric light. Mr. Harrison, opposing the amendment, said he had no intention of saying one word against the way in which the Gas Committee had done their work. However, electric lighting being a completely new department should be entrusted to men who had a thorough knowledge of electrical work, and could not be accused by any of the enemies of the Gas Committee of want of sympathy with the light. The work, it seemed to him, was going on with extreme slowness. Everyone knew that the Committee did their work as well as any of the others; but they were largely influenced by their Manager, who was not a believer in the electric light. Mr. Young denied that there had been any unnecessary delay in proceeding with the works. As soon as powers were obtained, and the Council had given their sanction to them being put in force, a Sub-Committee was appointed, who selected the site, on receiving a report from Professor Kennedy; but a question as to the title had for a time retarded the work. Alderman M'Connell, admitting that the Gas Committee had done their duty well, thought that the electric-lighting scheme ought to have been in a more forward state. Alderman Pirie believed it would be to the interest of Belfast to have a slight competiton between lighting by gas and the future lighting by electricity; but he regretted that any impression should have got abroad that the proposal in the Standing Orders was hostile to the Gas Committee, for nothing could have been further from his mind. Mr. Andrews, as a member of the Gas Committee, supported the original motion; remarking that he had perfect confidence in the Committee, but they were fully occupied. Mr. Henderson stated that he intended to vote for the amendment. It seemed to have been forgotten that, owing to the very disastrous strike in the coal trade, the Gas Committee had incurred a loss of some £20,000, which they would have to face in the coming year; and he thought the members of the Corporation, remembering that they owned the gas-works, should oppose anything that would handicap the Committee in the ensuing twelve months. On the amendment being put to the vote, sixteen members voted in its favour, and seventeen against it; and the original motion was then carried.

At a latter stage of the proceedings, the following report of the Gas Committee was submitted: "Your Committee have to report that, notwithstanding the great demand for gas in the heaviest week in the year—viz., that preceding Christmas—they were able to keep up the supply by getting the new water-gas apparatus to work earlier than was originally intended; and they are glad to say with extremely satisfactory results. They have received tenders for the various works connected with the electric-light installation, and have fowarded them to Professor Kennedy for his report." Alderman Connor, in moving the adoption of the report, said the Council would observe that the new water-gas apparatus had been got to work, with very satisfactory results. He was glad to be able to say that this important addition to the means of production had been sucessful; and he questioned if they could have got through the recent crisis without the additional supply from this source, though only one-half of the apparatus was in operation. The gas was richer in quality than that produced from the present supply of coal; and he had no doubt the gas would give greater satisfaction to the public than it had done for some time past. Mr. Young seconded the motion, which was agreed to.

THE GAS AND WATER WORKS PURCHASE QUESTION AT KENDAL.

A keen controversy is being carried on at Kendal with reference to the Corporation scheme for the purchase of the gas and water works. A poll of the ratepayers is to be taken next month, with the object of securing a reversal of the adverse decision of the public meeting; and, in the meantime, the 21 members of the Town Council who favour the scheme are pledged to make an energetic canvass of their constituents, with a view to securing votes in its behalf. Methods of agitation cannot be monopolized by either party; and there is little doubt that the opponents of the scheme will be equally energetic in placing their views before the ratepayers. Whatever may be the result, the good people who are to decide the question are, therefore, likely to be overwhelmed with statistics (which are being manipulated in the customary confusing way), and bombarded by the conflicting opinions of experts, between whom they have no means of discriminating.

The strong point with those who advocate the purchase of the Gas and Water Company's undertaking is that it is desirable, at all costs, for the Corporation to have control of the water supply. Kendal has admittedly suffered more than the average amount of inconvenience from the droughts of recent summers; and a more adequate and more reliable supply of water is an absolute necessity. If the water-works could be separated from the gas-works, there are probably not fifty people in Kendal who would object to its acquisition by the Corporation. As it is not proposed to separate the undertakings, and as there is a suspicion that the Company have had a little the best of the bargain, the opposition is keen and vigorous, though its exact aim is not by any means clear. If the proposed scheme were defeated, the Company would, no doubt, go to Parliament for an extension of their powers, and, having secured additional capital, would carry out some such scheme of water-works extension as Mr. G. F. Deacon has suggested to the Corporation. But, in this event, the Corporation, although they might obtain more advantageous terms than they possess under existing Local Acts, would be as far as ever from getting control of the water supply. The opposition would, in a word, have defeated itself. From the Company's point of view, it would seem to make very little difference whether the bargain is completed or otherwise. If they sell, they get a fair, though not an extravagant price; while if they retain the works, they will still possess an undertaking which, even under modern sliding-scale and auction-clause conditions, will be capable of realizing handsome profits. A good deal of the present controversy turns upon the price proposed to be paid for the undertaking. In the opinion of the advocates of the Company's scheme, a splendid bargain has been made; while its opponents just as strongly assert that the price to be paid is extravagant. Those who have no very strong feeling on the subject, one way or another, content themselves with saying that, if the sum is larger than it ought to be, it is desirable for the Corporation to pay it in order to get control of the water supply; and that, in a matter of this kind, it would be easy to waste on litigation a larger sum than is represented by the difference between the sum to be paid and that which the opponents of the purchase would admit to be a fair price.

The Corporation, it is clear, cannot make extravagant "profits" for the relief of the rates out of the gas and water works, if they acquire them. They are to pay for the undertaking a total sum of £86,960; and they estimate that £1370 will be required for immediate extensions, £2800 for working capital, and £1250 for the expenses of the Bill—a total of £92,380. It was originally estimated that the interest and instalment of sinking fund on this loan would amount to £3982 per annum; and as the profits for the year ending June, 1895, are estimated at only £3831, there was an apparent deficiency of £151 to begin with. Since then, however, the estimate has been modified in one or two important details. It is now anticipated that the Corporation will be able to raise the money which they require at 3 per cent., instead of 3¼ per cent. as originally estimated; and that they will be able to invest their sinking fund at 3 instead of 2¾ per cent. They further hope to induce Parliament to grant 60 years for the repayment of the loans, in place of the 50 years originally estimated. The net effect of all this, with some deductions *per contra*, is that the Corporation financiers expect to have £200 to the good upon the year's trading. But an essential part of the scheme is the construction of a new reservoir and other works of water supply. The cost of these is estimated at £28,800. The interest and sinking fund on this item are put down at £1211; but as £850 is to be saved annually by the abolition of the present pumping-station, the net outlay on account of the water-works extensions is estimated at only £361, which, however, is more than sufficient to swallow up any profit which, on the most sanguine estimate, the Corporation will be able to make. Naturally, the opponents of the purchase have made the most of these figures, on which they place their own interpretation; and the ratepayers have been strongly urged not to commit the town to a scheme which, as they urge, must inevitably result in an increase in the rates. To this the reply is that, if the Company are left to carry out the extensions of the water-works, the cost will still have to be borne by the ratepayers. Another argument which the opponents of the scheme put forward is based on the advance of the electric light. This has, however, not proved a strong card to play; and at the meeting of ratepayers, the owner of one of the local installations gave some statistics as to the cost of electric lighting, and expressed the opinion, based on experience, that the gas-works had nothing to fear from the competition about which so much has been said. On these subjects, and others of similar importance, the people of Kendal will hear a good deal before the question is submitted for their decision. Not content with the prolonged discussion at the public meeting which was held a few days ago, the two parties into which the town is divided are eagerly debating the subject in the local papers; and the controversy will, no doubt, be maintained until the eve of the poll.

Fatal Oil-Lamp Accident.—An inquest was held at Liverpool last Tuesday touching the death of Thomas Ryan, 25, a marine fireman, who occupied apartments with his wife in the house of his parents. During the evening of Boxing Day, it appeared that Mrs. Ryan was placing a jug on the mantelpiece, when her elbow struck a paraffin lamp, and knocked it over. She was quickly enveloped in flames; and her husband, in the attempt to extinguish them, had his own garments ignited. He rushed downstairs and into the street, where another man put out the fire. Both Ryan and his wife were conveyed to the Northern Hospital, where the former died on Sunday morning. A verdict of "Death from accidental burns" was returned.

The South Metropolitan Gas Company's Workmen and the Employers' Liability Bill.—Last Thursday afternoon, meetings of the employees of the South Metropolitan Gas Company were held at the works in the Old Kent Road and at Greenwich and East Greenwich, in support of Lord Dudley's amendment to the Employers' Liability Bill. Mr. C. Burrows, the Chairman of the Workmen's Committee, presided at the first meeting. He said the insurance schemes in connection with the various railway companies and other employers of labour throughout the country were of immense benefit to the men. The certainty of compensation for accident, fatal or otherwise, insured by systems of mutual insurance, such as that in existence at the works of the Company, was far preferable to the uncertainty attendant upon actions to recover damages, more especially seeing that it was necessary to prove negligence. Many accidents occurred which arose solely through the carelessness of the person injured; and whereas the insurance schemes provided for such cases, the Bill would not do so. Resolutions were passed in support of the amendment. A similar resolution was passed at a meeting held at the Vauxhall station on Friday, at which it was stated that the Chairman of the Company had had nothing whatever to do with its organization.

THE EFFECTS OF THE COAL STRIKE.

In *The Times* on Monday last week, there was a long article on the above subject, from which we make a few extracts.

The writer begins by admitting that we shall never know, with any approach to quantitative accuracy, what has been the effect of the strike on the prosperity of those who are engaged in most of the trades where coal is used; the losses of the workpeople directly affected, and those of tradespeople incurred through bad debts run up during the strike; or the actual destruction of wealth by malice or accident, which was one of the incidents of the struggle. All that can be positively asserted is that, owing to the strike, the whole community was, at the end of the struggle, poorer than it would otherwise have been—in the first place, by the non-possession of a certain number of tons of coal, iron, and other articles out of the total that would have come into existence and remained unconsumed for future use if there had been no strike; secondly, by the non-possession of commodities which would have been obtained by the consumption of, or in exchange for, another part of the total of these articles; next, by the deterioration of plant and machinery which could not be properly looked to during the strike, and by the destruction of a certain amount of plant and machinery through riot; and, lastly, by the loss of interest on capital expended on plant kept in repair, but only partially employed during the strike, as in the case of certain railways. Apart from all this, the *physique* of the men has no doubt been impaired by the insufficiency and inferior quality of the food they obtained during the struggle, and especially towards its close. In October the rate of paupers per 10,000 of population was 328 in the Wolverhampton district, 288 in Barnsley, 275 in Hull, 289 in Wigan, and 353 in Stockton-on-Tees—all above the average for places outside the coal centres.

The writer then proceeds to give a *résumé* of the statistics available, grouping them into three classes—viz., those relating to production, and to a small extent consumption; (2) those relating to means of communication and to movements of commodities; and (3) those relating to labour. Unfortunately, the only available statistics bearing directly on the first class are the returns of blast-furnaces at work before and after the commencement of the strike. On June 30 last, there were 90 furnaces in blast in Derbyshire, Lancashire, Northamptonshire, Nottinghamshire, North Staffordshire, and Yorkshire (West Riding); whereas on Sept. 30 the number was only 43. Important as these figures are, as indications of the loss of money to ironmasters and the distress to workpeople in the Midlands, they cannot be taken as evidence of the state of the iron trade of the country as a whole; the production of pig iron in Cleveland and Scotland, especially the former, forming the bulk of the supply. The Scotch ironmasters put many of their furnaces out of blast when the strike began, owing partly to the active competition of Cleveland; and the number blowing at the end of the strike was only 46, against 71 at the beginning of July. In Cleveland, on the other hand, there were actually more furnaces in blast in the months of August and September than in July; and, although four were put out in October, there was no diminution worth mentioning in the make during the three months ending Oct. 31. During November, however, four furnaces were thrown out of use. As the make of iron was so much reduced, the manufactured iron and steel works in the Midlands and South Yorkshire were unable to obtain all the material they wanted; and this, together with the increased cost of engine fuel, seriously checked their output. The reduction in the quantity produced in the area affected by the strike was, as already stated, to a large extent balanced by the increased activity in Cleveland. The falling off in the shipments of all kinds of iron and steel from the United Kingdom during the three months ended Oct. 31 was only 3·2 per cent.; the short supply from the Midlands having been to a great extent made up by the increased supply elsewhere. During the first seven months of the year, there was a large increase, amounting to 14·6 per cent., part of which arises because the comparison includes the period of the Durham strike. But a good deal of it may fairly be attributed to the extended demand for iron and steel abroad; for several items showed increases even after the coal strike must have made delivery of orders more difficult.

Discussing next the effect of the strike on railway traffic, the writer shows that there was a falling off of £2,367,619 in the receipts last year as compared with 1892. The most serious loss was, of course, with the Midland and South Yorkshire group of lines. This decrease of revenue was not compensated for to any great extent by the smaller number of goods and mineral trains run. The scarcity of coal hit the railway companies very hard on both sides of their account. They had less of it to carry; and they had to pay more for what they consumed, not only because of the rise in the price at the pit's mouth, but because in many cases they had to arrange for bringing what they required from comparatively remote districts, the produce of which they do not usually buy. Both the Great Northern and the Midland, for instance, naturally use a good deal of South Yorkshire fuel; and this they had to replace temporarily by coal from South Wales and Durham and Northumberland—paying more both for the article itself and for conveying it to the points where they required it.

With regard to the effect of the strike on other industries, the writer states that the leading commodities interfered with were iron, copper, lead, and alkali, while a few others have been imported in slightly larger quantities. On the other hand, in some cases the rate of importation has actually slackened a little. This is the case with tin, crude zinc cakes, and woollen manufactures. There was an appreciable increase in the rate of arrival from abroad of petroleum and paraffin, the former of which can in certain instances be used as a substitute for coal. The high price of coal has naturally led to the sinking of many new mines and the re-opening of some that had been shut down. In September last, 35 mines were opened, and 2 abandoned; and in October, 39 were opened and 10 abandoned. Of the 74 mines thus opened, 16 were in South Wales, 14 in Lancashire, 9 each in Scotland, Derbyshire, and Staffordshire, and 6 in Durham; the remaining 11 being in various other counties. The writer remarks that this rapid addition to the number of pits whence coal will presumably be obtained in future is of more importance as a suggestion of what would happen if coal were to remain dear for any considerable period, than for any effect it is likely to have immediately on the volume of the output, or on prices. We use the greater part of the coal raised in the United Kingdom now ourselves, and cannot do without it. The export of coal is less than one-fourth of that won. The total obtained last year was about 182 million tons, of which about 39 million tons were exported, including about 8,600,000 tons of bunker coal taken by steamers engaged in foreign trade. The whole of the remainder of the coal raised is consumed within the United Kingdom. If the cost were to be permanently increased, owing to the closing of existing mines, or their running short time, by only 25 per cent., people engaged in many industries which have sprung up and continued to exist owing to the price of coal having remained within known limits for some time, would find themselves in difficulties, and would either gradually give up business or would set about reducing their consumption of coal. All those great industries into which the cost of coal enters largely, and which cannot reduce their consumption immediately, such as railways, would be incited to make fresh efforts to employ petroleum or some other heating agent, or, if they could not do that, would have to economize in some other way, by giving less frequent, rapid, and good accommodation to their customers. Gas companies could and would raise the price of gas. In connection with this subject, the writer notices the fact that the Gas Committee of the Birmingham Corporation, having lost £25,000 by the strike, had decided to raise the price 3d. per 1000 cubic feet; and what an "enlightened" Municipality finds itself compelled to do would, he says, certainly be done by companies which make no pretence of philanthropy in their business. In concluding this part of his article, he points out that there is hardly an article in common use which would not, to some extent, become less plentiful, and consequently less cheap, if coal became permanently dearer than it has been, on the average, during the last ten years. Such a result would cause inconvenience, and even positive discomfort, to the great majority of the inhabitants of this country; and, as usual, when anything happens to disturb the working of the economic machine, the least wealthy members of the community would suffer most. "The aggregate of hard-working persons, known in the political slang of the day as 'the masses,' are far more interested in coal being plentiful than their leaders suppose; and they will become painfully aware of this fact before very long, if the coal miners persist in clinging to the theory which has been invented for their benefit, that the price of coal can be raised as much as they and the coal-owners choose. The dearness of coal would, of course, tend still further to encourage the opening of fresh pits, which could be worked at first at a low cost; but eventually either pitmen's wages would have to come down to a level admitting of the price of coal being reduced, or otherwise many industries would cease to exist."

Appended to the article are a number of tabulated statistics bearing upon the question discussed.

SOME NOTES FROM AMERICA.

From Our American Correspondent.

The Commissioners appointed by the Legislature of Massachusetts to value the plant of the Bay State Gas Company have completed their labours, and have reported to the effect that $2,000,000 would be a fair valuation. This will permit the Company to issue $1,500,000 more capital; but they will be compelled to take care of the note to which reference was made in your issue of Oct. 17. The figure seems a low one when allowance is made for the capacity of the plant, which was stated by witnesses to be 5¼ million cubic feet. Looked at from this standpoint, and considering the capital invested in gas-works in other cities, and allowing that the Company is essentially a manufacturing one, and has not a full distributing system, it would seem that $4,000,000 would not be an excessive figure. And if we have regard merely to the structural value, the report of the Commissioners would seem to be Conservative, to say the least, as the plant is solidly built, the work well done, and a great deal of money has been spent to produce, I might say, a quiet, elegant effect—beauty without gaudiness. However, the report is made; and there is no ground for supposing that the Company will do aught but make the best of the situation.

The case of the Wakefield Gas Company and the town of like name is again before the public; and the topic, to use a strong phrase, is getting rather "chestnuty." It will be remembered that there has been considerable feeling between the two parties interested, and the town had (acting under the law of 1891) voted to go into municipal lighting, eventually trying to back out when it came to the question of buying out the established Company, and were evidently surprised to find that they could not retrace their steps. Now the case is up before three Commissioners appointed by the Supreme Court, to appraise the value of the property. One witness has placed the figure at $250,000; and the town is trying to break that valuation. It is a small affair; but it has excited considerable attention, as it is the first gas undertaking brought under the law of 1891.

The town of Newton (a residential suburb of Boston) is agitating the question of a municipal plant, claiming that the prices charged are high. If the Government was disposed to proceed in the matter according to law, there would be no complaint in the matter. But they are inclined to step over the statute, which requires them to buy the existing plant; and they are petitioning the Legislature for special powers in the premises. This will doubtless lead to a fight in the State House this winter.

Middleboro (Mass.) is another town which has just voted to go into the lighting business by purchasing the gas and electric plants there. It is said that the works have cost $170,000, and can be purchased for $63,000. In regard to the former figure, considering the smallness of the town, it is fair to assume that the electric plant has been put in at "long figures." However, the Company have not been a success from a financial standpoint; and they are doubtless very ready to sell.

If further evidence is needed to bear out the statement that lighting matters around intellectual Boston are exciting, I might instance the hearing which has just been held before the Gas Commissioners on the petition to reduce the price of gas at Charlestown. This place is in Boston municipally speaking, but is out of it geographically—that is, it is part of the municipality, but is separated from the city proper by

he Charles River. The price of gas there is $1·50, which is 50c. in excess of the rate across the river. Hence the petition. As an instance of the statement that evidence once given may later prove a "boomerang," it might be noted that the main part of the case of the petitioners is evidence given by the Treasurer of the Company at the State House last year, as to the cost of gas making. This case the Commissioners have under advisement. It is very likely that a reduction will be ordered here. This seems the more probable from the fact that the Company supplies gas to half of the town of Somerville; the remainder of the municipality being lighted by the Cambridge Gas Company. Now it so happens, that the last-named Company, supplying also the old city from which it takes its name (the city which is the home of Harvard College), has been having a little gas fight of its own, and has had to reduce the price of gas to $1·35. Hence, in Somerville, along the line dividing the district supplied by the Charlestown and Cambridge Companies, the residents of one side of the street have gas at $1·35; while their opposite neighbours pay $1·50.

Speaking of Cambridge reminds me that, when a fight once starts between a city and a gas company, it is hard sometimes to stop it; for in this city the Company have always charged a rather high price for gas, and, paying good dividends, were looked upon by other companies with envious eyes. But it would seem that they may have to meet some of the troubles other companies have experienced, as, notwithstanding the substantial reduction made in the price of gas (which, however, was not made until after the agitation on the subject), they have now to face the question of municipal ownership. The City Government have recently been investigating this question; and the Committee so charged have made an extensive report, in which they dwell particularly on the electric side of the question, and give figures of cost, or purported cost, of providing the electric arc light in cities owning their own plants. Cambridge pays $115 a year per arc light; and the Committee note municipal plants where the cost is only $54. But they do not state—perhaps they did not discover—that this figure does not include interest. The report takes up the consideration of the municipal electric plants at Braintree and Peabody, both in Massachusetts, and states that the latter place having 150 arcs produces them at a cost of $70·42 per year, running on moonlight schedule; and the Committee add that, if the lights were run all and every night, the cost would be only $75. Therefore, the Committee inquire why, if a small place like Peabody can make the lights for $75, should Cambridge pay $115. The Committee heard the President of the Electric Light Company on this question; and he made much of the fact that the Company was started when the industry was in an experimental stage; that the price of machinery was very high then; that much of it has since become antiquated, and the business did not afford sufficient profit to wipe off this old machinery from the capital account; that they were entitled to a return on the same; that it was not fair to figure the worth of the plant at its present structural value, but it should be taken at what it cost the Company; and that they could not earn dividend on this capital at less than $110 or $105 a lamp. The Committee, therefore, reported in favour of a municipal plant.

Milwaukee, Wisconsin (a very flourishing town of the north-west), has felt the effects of the general business depression of the country very much, and has had to stand up against several banking-house failures. A very curious suggestion comes up in connection with this aspect of affairs—that is, one of the defunct banks was carrying a large amount of gas stock as collateral security; and it is intimated that, as the securities will probably have to be sold by the receiver, the City should buy them, with the idea that it would be an entering wedge towards a municipal plant? This is certainly a curious suggestion, to have a City become a minority stockholder in a gas company—in fact, it will probably be found a little too curious for realization.

An investigation into the matter of street lighting at Washington, D.C., has been in progress during the last summer, with the object in view of getting more light for the money now paid, or the same service for less money, or both. The officer in charge of the investigation has just made his report, in which he claims that Washington is poorly lighted, and pays roundly for the service. But he has been unable to get any better figures, on account of the lack of authority vested in the Commission. It seems the officer under the direction of the Commissioners advertised for bids for periods of one, five, and ten years; but no answers were received. This is explained, as already intimated, by the fact that the Commissioners did not have authority to make a contract with a desirable bidder, but would have reached the limit of their authority when they had made a recommendation to Congress. Under such circumstances as the officer points out in his report, it was not to be expected that capitalists would go to the expense of forming a lighting company. Regarding the existing Companies, the report states that there is naturally no competition between them, as Congress makes a direct appropriation of a certain sum for gas lighting, and a given figure for the electric service. Thus, as each Company is assured a defined amount of money, there is, as would be expected, no rivalry between them. The officer proposes to meet this supposed evil by having Congress make, so to speak, a blank appropriation for street lighting, and allow the Commissioners to determine how it shall be spent. The report also recommends that authority be given the Commissioners to put up a municipal lighting plant, the cost of which is placed at $1,700,000; and it is figured that interest at 3 per cent. and depreciation at the same figure, with operating expenses, would give a total expense of $200,000, "whereas, under the existing system, the city is now paying $209,200 per annum for a service which is much more like that of a large and thrifty village than like that of the most beautiful capital of the world." It must be admitted that Washington is inadequately lighted; but on the basis of this estimate, it had better keep out of municipal lighting. Interest at 3 per cent. in this country is low; and 3 per cent. for depreciation is lower—way down below reason. In truth, these two items rightly figured on the proposed investment, would well-nigh use up the figure now paid for lighting. Washington had better find some other way out of the dilemma.

Minneapolis is also getting interested in street lighting; and oddly enough on the 1st of September it made a five years' contract with the electric light company. It then agitated the question of a municipal electric plant; and it is now endeavouring to break the bargain already made. This it tries to do in a rather peculiar way; for the local Court has been petitioned to declare the contract void as it was made for more than one year. This decision has been given; but it will doubtless be reviewed by a higher Court, and the outlook is that Minneapolis will have to wait for its municipal plant.

An attempt is now being made by the City Government of San Francisco to reduce the price of gas in that city. The present rate is $2 per 1000 cubic feet, which the powers that be say is high. They want it brought down nearer to Eastern prices; but their demands do not appear to be founded on justice. While $2 is a higher rate than is paid by eastern cities of the size of San Francisco, it is also true that the Gas Company have to pay higher prices for all their supplies. The *San Francisco Call* takes up this aspect of the case, giving prices of supplies in other cities as compared with those prevailing in the municipality under discussion. The figures are given in very extensive form; and I can best epitomize them by resorting to the tabular plan.

City.	Make of Gas in Millions.	Price of Gas.	Cost of Anthracite Coal.	Cost of Bituminous Coal.	Cost of Oil.
		Dollars.	Dollars.	Dollars.	Cents.
San Francisco . .	938	2·00	7·50	6·50	7·17
New York . . .	7000	1·25	3·65	3·75	2·50
Chicago	3946	1·20	4·40	..	1·78
Philadelphia. . .	3400	1·50	4·10	3·49	3·00
Boston	1275	1·30	4·00	3·75	3·87–½
Cincinnatti . . .	1076	1·25	..	2·52	..

The cost of coal is, of course, per ton; and that of oil is in cents and decimals thereof per gallon. It is also claimed that the price of iron pipe and other supplies is very much higher than in eastern cities. The same paper also calls attention to the recent large extensions of the Gas Company's plant by the erection of entirely new works, giving at present a manufacturing capacity of 8 million feet a year. As your correspondent had an opportunity of inspecting these new works recently, he can testify to their being valuable additions to the Company's plant. The capital stock of the Company is $10,000,000; and, in addition, they have $1,500,000 in bonds. They pay a dividend at the modest rate of 4 per cent. The pay-roll embraces 600 men; and the rate is $2 per day and upwards. This again is higher than rates east, where a labourer usually gets $1·50. If a person runs across the high rates for all classes of goods prevailing on the Pacific Coast, he is surprised unless he has previously thought of the great cost of transporting goods over the prairies and the Rocky Mountains. Giving this point due consideration, it would seem that the prevailing figure is a reasonable one.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Amalgamation, or rather consolidation, of forces is apparently to bulk largely in the public life of Scotland during this year. The subject has been before the communities of both Glasgow and Dundee this week. In Glasgow, it came up on a recommendation by the Finance Committee that a proposed clause in a Corporation Bill, giving power to the Treasurers of the gas, water, and other departments to borrow money from the public for temporary purposes, should not be inserted in the measure. Treasurer Gray moved the recommendation of the Committee in the Town Council on Thursday. He spoke strongly in favour of the retention of the system which was originated by the Bill of 1883, by which were consolidated all the finances of the Corporation, except those of the Improvement Trust. As that Trust was now likely to be permanent, he considered that it and the "Common Good" should be placed under the Act of 1883. He thought that, to allow the Treasurers of the different departments to go direct to the public whenever they wanted money, would lead to confusion in their finances, and would perplex lenders; and that it was better to have one controlling and supervising Committee, one medium, one office, one system, one set of books, registers, and accounts, and one professional audit. The insertion of the clause was moved by Dr. Colquhoun. He explained that the Bill provided that the whole of the temporary borrowing should be done through one officer—the Registrar; and that the proposed clause gave the Council power, in exceptional circumstances, to vary that rule. Its intention was to leave the hands of the Council free, and not to tie up those of their successors by a hard-and-fast rule. The Clerk (Sir James Marwick) explained that the proposed clause would not interfere with the power of the Treasurers of departments to overdraw bank amounts for a short time. It was suggested that the power to borrow should be for a limited, instead of for an indefinite, time; and Dr. Colquhoun agreed to the proposal. The clause was then approved by 38 votes to 31. The result, therefore, is not altogether an approval of consolidation; but as the power, if obtained, is not likely to be often used, and seems to be only possible of use with the sanction of the Council, it will not greatly affect the general provision requiring all funds to be consolidated. It is difficult to see what benefit will arise from the new clause, unless it be the view of some of the departments that they can more easily persuade the whole Council to allow them to borrow than to get the Finance Committee to consent. If that be so, the new provisions will not be helpful to the economist, because it will remove the controlling power, and make it more difficult to watch and repress lavish expenditure. Of course, it will be open to anyone in the Council to move refusal of power to any department to borrow; but the Council, being a more heterogeneous body than a specially appointed Committee, such a motion has not the same chance of success as it would have were it backed by the recommendation of a Committee. The other side of the question is that a Finance Committee, not charged with the conducting of any of the spending departments, may by restrictions, tend to hamper the work of the departments, and really lead to extravagance instead of economy. I rather think, from the vote, that this opinion is entertained.

In Dundee, the subject was discussed at length in the Gas Commission on Wednesday, in connection with the Corporation Bill, in which

power is sought, among other things, to amalgamate the Gas and Water Commissions with the Town Council. Lord Provost Low moved that the Gas Commission should co-operate with the Town Council in promoting the Bill. As at present constituted, the Gas Commission consists practically of six members of the Town Council, five representatives of the Guildry, six of the Chamber of Commerce, and four of the Nine and the Three Trades. The Town Council is thus only 6 out of 21; or, if the heads of the other bodies, who are also members of the Town Council, be included, they are 9 out of 21. That this is an anomaly, few outside the represented bodies will deny. t arose from the fact that in 1867 the then Town Council sought the assistance of the represented bodies in obtaining the transfer of the undertakings of the two local Gas Companies. Lord Provost Low admitted that the Gas Commissioners had done excellent work; but he gave several reasons why the Town Council should appoint the whole Gas Commission, or rather should themselves be the Gas Commissioners. The Gas Commissioners, he said, had power to assess the citizens to any extent. The argument that large consumers should have special representation on the Commission might be used equally well with reference to the Water and Police Commissioners; but no large consumers of water, or large manufacturers, sought representation on those boards. He himself was a member of the Town Council, the Chamber of Commerce, the Guildry, and the Nine Trades; and thus he had a four-fold vote in appointing members of the Gas Commission. At the present time they had on the Gas Commission, as the representative of one of the outside bodies, a gentleman who, so far as he knew, was not a ratepayer in Dundee or a consumer of Dundee gas, and who, if the gas-works were blown up, would not be called upon to pay a penny of the loss. Mr. Paul, a representative of the Nine Trades, moved the previous question; and founded his reason for doing so upon past service. He was also afraid that, if the Town Council had the entire control of the gas undertaking, they might, if there should be a deficit in the police accounts in any year and a surplus in the Gas Commission accounts, make up the deficit from the funds of the latter. Mr. J. Mitchell, a member of the Guildry, moved that an agreement which was come to in 1890, to the effect that the first time the Gas Commission went to Parliament power should be taken to increase the representation of the Town Council so as to give it a majority, was right in principle; and that they should appoint a Committee to confer with the Town Council as to giving effect to that arrangement. This latter motion was adopted by the Commission, by 9 votes to 7. This result is also opposed to consolidation; but it is of little value, as there is not much doubt that the amalgamation proposals of the Town Council will be carried.

Another explosion in an electric light conduit took place in Glasgow on the evening of Friday of last week. This time the explosion was the effect of an overt act. Half of the electric lighting in the large central Post Office building went out in the course of the evening, leaving the place in darkness; and work had to be conducted by candle light. This should be a warning to people in Glasgow who propose taking in electric lighting not to have the gas-fittings removed. As soon as the casualty at the Post Office occurred, men were sent from the electric lighting station to endeavour to discover the fault which had caused it. They lifted a manhole cover at the corner of West George Street and Dundas Street, and looked in with a light. There had been gas in the conduit; and it at once ignited, burning three men rather severely. It is thought that at present there is more likelihood of gas escaping from the mains than there will be after some time, because there is work going on in some of the central streets in connection with the sewerage.

A second explosion of gas occurred in Glasgow on the same evening; but it was of the ordinary sort, and is of less moment. The only peculiarity about it is that it took place inside a railway tunnel. The North British Railway Company have a private gas-works; and they convey gas from it to Queen Street station by a pipe along the wall of the tunnel. It was known that this was leaking; and before it was repaired the explosion occurred. What caused it is not known; but no one was injured.

Almost contemporaneously with the announcement that the Stirling Gas Company are about to introduce Young's oil-gas process, it is given out that the Corporation have resolved to oppose an application by the Caledonian Electric Supply Company for a Provisional Order, to enable them to introduce the electric light into the town. Of course, their opposition is not in order that they may support the Gas Company in their endeavour to improve the lighting of the borough; what they contemplate is the taking of power to introduce the light themselves. The business men of the town prefer that the Company should get the power; and they have resolved to ask the Town Council to rescind their resolution. Probably in this action the business men have their judgment disturbed by the glamour of a large scheme which the Caledonian Company have put forward, in which it is proposed to include a wide district of country, embracing the towns of the Bridge of Allan, Alva, and even Alloa in the area of supply. It does not seem to be realized that such a scheme would be more costly than if they were to have an installation for themselves, because they would, in addition to the central works, have to pay for the construction and maintenance of about ten miles of mains which would for the most part be unproductive.

An insurance collector in Paisley, named M'Callum, has been sent to prison for 21 days, for stealing gas from the Corporation. The period stated in the complaint was from Jan. 1 to Dec. 18, 1893. The method employed by the thief was, in the absence of a meter, which had been taken away when the former tenant left, to connect the ends of the gas-pipes by means of an india-rubber tube. This is a form of theft so easy to perpetrate, that it is a wonder it is not oftener done. Gas officials should be particular to watch for it.

An arbitration has been proceeding before Mr. Murdoch Paterson, C.E., between the Corporation of Inverness and Messrs. Newton, Chambers, & Co., of Thorncliffe Works, near Sheffield, as to a claim for extras in connection with the construction of a new gasholder at the Inverness Corporation Gas-Works. The claim by the contractors was for £316 15s. 9d., in respect of wages, interest, &c. The Arbitrator, after hearing proof for two days, has allowed £160, with interest on the unpaid balance of the price from March 23 last—the date of the last certificate. A claim for over £800 by Mr. R. Fraser, the contractor for the excavation of the tank, has yet to be dealt with.

The Airdrie and Coatbridge Water Company, who obtained powers in 1892 to construct a large reservoir in the neighbourhood of Biggar, are experiencing great difficulty in the construction of it, in consequence of the opposition of the proprietor of land adjoining the site. The difficulty is as to getting access. Mr. Paterson, the proprietor of Birthwood, first obtained interdict of their using a private road for this purpose. The Water Company then served a notice upon him of their intention to take a portion of his lands for laying and maintaining a pipe-track. On the ground that the intention was not for the laying of a pipe-track, but for the construction of a road by which to convey the heavy materials necessary for the construction of the reservoir, Mr. Paterson again sought interdict; and that action is in dependence. A third interdict has been applied for, against the Company proceeding to construct the road while their right to do so has not been conceded. This matter came before Lord Kyllachy in the Bill Chamber yesterday; and his Lordship passed it on to the Court of Session, remarking that it was one thing to make a road as they went along laying pipes, and another to make a road which anybody could see was for a different purpose. The whole question in dispute is the amount of compensation to be paid to Mr. Paterson. His opposition may be greatly influenced by the fact that the site of the reservoir is on land of Lord Lamington, and not on his own estate.

The Police Commission of Arbroath have received a report from Professor T. Claxton Fidler, Professor of Engineering and Drawing in University College, Dundee, with regard to the water supply of the town. The supply is derived from two wells sunk within the town, augmented by private wells, some of which have been condemned as yielding impure water. Professor Fidler finds that the public supply averages 152,000 gallons per day, which is only equal to about 6¾ gallons per head of the population. This is ridiculously inadequate; and it is only possible to make it at all available for the requirements of the community by placing the delivery to every house under meter, which was done some years ago. Even under the meter system, the consumption has increased till it now averages 157,000 gallons per day, which, of course, the wells are unable to meet. The people are therefore obliged to use dangerous private wells. With such a limited flow of water, it is found that the public sewers silt up, which is another source of danger to the community. Professor Fidler suggests that provision should be made for a supply of 14 gallons per day per head—a quantity which many will think altogether inadequate. In ten or twelve years he estimates that the quantity required will be 500,000 gallons per day. At present 320,000 gallons per day will suffice; and to provide this, he suggests the sinking of another well and the provision of connecting galleries, as well as the construction of a service reservoir at a higher level than the present storeage-tanks, and more powerful pumping plant. The water is derived from a gravel bed, which lies below about 32 feet of boulder clay, over which is a layer of sand about 7 feet in thickness. It is from this layer of sand that he considers the private wells derive their supply. The boulder clay he looks upon as a sufficient protection from surface waters; and to keep these out of the wells, he recommends that they should be lined with concrete masonry to within about 10 feet of the bottom. Analyses have shown that the under water is pure and suitable for domestic supply. The cost of the works suggested by Professor Fidler he estimates at about £5000. He cannot, with confidence, in view of future possible extensions of the town, say that it will always be possible to keep the underground waters free from contamination; and if this difficulty should arise, he considers it would then be necessary to search for water in the sandstone which underlies the gravel bed, or to bring in a gravitation supply. The Commissioners are to discuss the report on Monday. They ought, considering the note of warning with reference to possible contamination, to satisfy themselves as to the cost of a gravitation scheme before adopting any extension of the present method of supply. The water supply is at present in a most unsatisfactory position; and there should therefore be no more time wasted in further consideration or experiment than is absolutely necessary.

The Proposed Purchase of the Penistone Water-Works by the Barnsley Corporation.—It is reported that the question of the Barnsley Corporation purchasing the Penistone Water-Works has fallen through. The Council passed a resolution, and the ratepayers assented to the Corporation proceeding with the scheme, if it was found to be desirable. The Water Committee have decided, however, not to go on with the project, although the Bill has been deposited.

New Joint-Stock Companies.—The following Companies have lately been registered: Bishop's Waltham Water Company, Limited, with a capital of £10,000, in £10 shares. Turin Water-Works Company, Limited, with a capital of £21,000, in £5 shares. '94 Tar Products Sales Committee, Limited, with a capital of £105,000, in £1 shares, "to carry on business as dealers in tar, tar products, and all residual anthracene or other products obtained in the manufacture thereof;" among the first signatories to the Memorandum of Association being Mr. S. B. Boulton.

Suggested Subways for Gas and Water Mains at Bolton.—At the monthly meeting of the Bolton Town Council last Wednesday, Mr. Broadbent suggested to the Chairmen of the Gas Committee and Streets Committee that, in the principal thoroughfares of the town, underground subways should be constructed for the gas, electricity, and water mains. He contended that not only would it be a convenience to the public, as fresh mains could be laid or repairs effected without pulling up the streets, but it would be more economical. He had been looking up the accounts, and was surprised to find what an enormous amount of money had been spent in the laying and renewal of gas and water mains. Alderman Miles, the Chairman of the Gas Committee, said, in reply, that this idea of subways for gas, water, and other mains was not new; but there were numerous difficulties about it. There was the danger of leakages and explosions; and then the cost would be exceptionally heavy. He could hold out no hope of any such scheme being adopted in Bolton for the present at any rate. No resolution was submitted on the point, and the matter dropped.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Jan. 6.*

Sulphate of Ammonia.—There is little animation in the market, a holiday feeling still prevailing; and during the last few days the severe weather seems to have caused buyers to put off their purchases. The parcels on the market have been few; and sellers generally have been asking £13 10s. But transactions have not been reported above £13 7s. 6d.; and to-day buyers could not be found above £13 6s. 3d. Dealers are also keeping back their requirements; and it may not be till after the middle of the month that more activity will prevail. Nitrate is steady and unchanged.

LONDON, *Jan. 6.*

Tar Products.—During the week, this market has been dull and uninteresting; and very little new business has transpired. The production of products at the moment is very large; and distillers are extremely busy with old contracts. The speculations made a few months ago as to an immediate decrease in the quantities of tar produced are not yet being realized. From appearances, the output at the moment is larger than it has been for many years. There is not, therefore, likely to be any dearth of products during the next few months. Prices, generally speaking, are easier, with the exception of pitch, for which slightly higher prices are being paid for spot delivery. Anthracene is very strong, and so will remain so long as The Gaslight and Coke Company continue to hold for 1s. 2d. per unit, which is their quotation. Stocks of anthracene are remarkably light—perhaps lighter than they have ever been before at this period of the year; and as the prospects of alizarine users are much brighter than they have been for a long time, anthracene is not only likely to maintain its value, but will probably be dearer. Quotations nominally are: Tar, 15s. to 16s. Pitch, 27s. 6d. to 29s. Benzol, 90's, 1s. 5d.; 50's, 1s. 6d. Creosote, 1¼d. Creosote salts, 25s. Solvent naphtha, 1s. 3d. Toluol, 1s. 8d. Crude benzol naphtha, 30 per cent., 8½d. Carbolic acid, 60's, 1s. 7d.; crystals, 6d. Cresol, 1s. 4d. Anthracene, 30 per cent., "A," 1s. 2d.; "B," 9d.

Sulphate of Ammonia.—There is no change in this market. Buyers are holding aloof in the hope of lower prices; but, as makers appear to be well sold, and stocks are low, the value is not likely to recede. The small business during the week varied between £13 5s. and £13 10s., less 3½ per cent.; while gas liquor is offered at 8s. to 9s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The considerable weight of buying which was going on prior to the holiday stoppages of the pits, necessarily resulted in a quiet demand during the past week; and the year opened with, if anything, rather an easier tone in prices. This was particularly the case as regards engine classes of fuel, which, it was understood at a meeting of representatives of Lancashire collieries held in Wigan, might be reduced 6d. per ton on the full prices recently agreed to. In the Manchester district, however, no change has been made; and generally prices are without really quotable alteration. The better qualities of round coal, for house-fire purposes, have not been in more than moderate request, as consumers are mostly well covered for the present. Best Wigan Arley, at the pit mouth, is only in special cases fetching 15s. per ton; 14s. to 14s. 6d. are very general figures for good ordinary qualities; second qualities and Pemberton four-feet average about 13s.; and common house-fire coals, about 12s. per ton. Steam and forge coals are in fairly good demand, both for inland requirements and for shipment; and although it is exceptional where 11s. per ton is being obtained, prices are firm at 10s. to 10s. 6d. for inland sales, with Lancashire steam coal, delivered at ports on the Mersey, readily fetching 12s. to 12s. 6d. per ton. Engine classes of fuel are fairly plentiful in the market; and outside supplies are competing at rather low figures, with the result that buyers can place orders on somewhat more favourable terms than recently. Burgy is not fetching more than 8s. to 8s. 6d.; best qualities of slack, 6s. to 6s. 6d.; and common sorts, 5s. to 5s. 6d. per ton, at the pit mouth.

Northern Coal Trade.—Since the conclusion of the holidays, the output of coal in the Northern coal-fields has been gradually returning to its full extent; and it is now so high that, large as are the orders and the contracts, they are being duly met. The demand for steam coal is perhaps slightly less than it was; but that for gas coal shows as yet no diminution. Best Northumbrian steam coal is quoted at from 12s. to 12s. 6d. per ton f.o.b. for prompt shipment; while about 10s. per ton is the price that contracts for delivery over next shipping season are expected to rule at. Second-class steam coal is about 1s. per ton below best; and small steam coal finds a tolerably ready sale at from 4s. 6d. to 5s. per ton. There is no great alteration in manufacturing fuel; but the tendency is to offer it at rather lower prices for forward delivery. In regard to gas coals, some of the new contracts at advanced prices are now being delivered under, so that the average receipts of the gas coal collieries are increasing. Deliveries are large, and will continue so for the rest of the month, as some of the most important companies desire to increase their stocks. Prices of gas coals are steady; and a few small contracts are being fixed at rates much the same as those larger ones entered into a fortnight ago. Coke is firm, and shipments are maintained; the rate being still 16s. per ton f.o.b. for best Durham qualities. Gas coke is dearer now; and the contracts that are usually settled at this time are based on the idea of an advance in price, about 8s. 3d. to 8s. 6d. per ton being asked on contracts for delivery over the whole of the year. Gas coke, however, is rather scarce, despite the large production.

Scotch Coal Trade.—The coal trade in Scotland has opened this year in a mixed state. There is a feeling of unrest and uncertainty among buyers, arising out of the possibility of a renewal of difficulties with the men after Feb. 1. Many are convinced that the men will give trouble; and they are disposed to purchase more heavily than they require. Others are as strongly of opinion that the men are not in a position, either as to organization or funds, to cause trouble for some time. To this view there is colour lent by the fact that, when last week a mass meeting was called to be held in Glasgow, as the first of a series in which the miners were to be consulted as to their views regarding the future, it turned out a failure. Evidently the men do not desire a renewal of conflict with their employers. On the other hand, there is to be taken into account the probability of a fall in prices, which may require a reduction in wages, and thus lead to the masters forcing the men into opposition. Quotations cannot be said to differ much from those given last week. They are: Main, 9s. 6d.; ell, 10s. 6d. to 11s.; splint, 9s. 9d.; and steam, 11s. to 11s. 3d. per ton, f.o.b. Glasgow. The shipments for the last week of 1893 amounted to 190,797 tons—an increase of 16,353 tons over the preceding week, and of 62,629 tons as compared with the corresponding week of 1892. During 1893 the total quantity of coal shipped from Scotland amounted to 7,802,919 tons—an increase over the total quantity in 1892 of 113,007 tons. Compared with 1891, the increase was 1,064,216 tons; with 1890, 1,578,986 tons; with 1889, 1,999,959 tons; with 1888, 2,757,586 tons; and with 1887, 3,206,136 tons. In the first half of the past year there was little demand; and shipments, at the end of June showed a decrease over the same period of 1892 of 380,278 tons. Then there was an improvement, which was greatly accelerated by the strike in the Midlands. So great was the demand for Scotch coal, that by the end of October the decrease was entirely wiped out, and increases began to be recorded. By the end of November, the increase over the same period of 1892 was 160,772 tons; but the strike in the West of Scotland has led to these figures being reduced as stated above.

Alterations at the West Bromwich Gas-Works.—The minutes of the Gas Committee presented at last Wednesday's meeting of the West Bromwich Town Council stated that they had resolved to transfer the sum of £2500 from the depreciation fund to the revenue account for the year, towards the extraordinary expenditure incurred in the construction of a new bench of regenerator furnaces, and the cost of providing and fixing a new steel boiler, fitted with one of Messrs. Meldrum Bros.' patent furnaces, in place of one now worn out.

The Price of Gas at Lytham.—A recommendation that the price of gas be increased by 4d. per 1000 cubic feet was brought before the Lytham Improvement Commissioners by the Gas Committee last Thursday. The Chairman (Mr. Pearson) stated that, since the previous meeting, it had been found that it would be illegal to raise the price of gas in the middle of the quarter. There would, therefore, be no change in the price charged for the December term; and the advance which was necessitated by the extra outlay during the coal strike would date from Jan. 1. The Committee's recommendation was adopted.

Electric Lighting at Brighton.—A report from the Lighting Committee was presented at last Thursday's meeting of the Brighton Town Council, containing recommendations for the extension of the electric lighting in the borough, including the acquisition of the goodwill and business of the Brighton and Hove Electric Light Company, Limited, for £5000, subject to terms set out in the draft agreement. In submitting the report, Alderman Moon stated that the number of lamps connected with the Company's system in September was 9665, with a consumption of 154,000 units. Besides the £5000 purchase-money, the Committee asked the Council for £19,227 for additional plant and mains. Certain alterations which it was proposed to make would result in a saving of about £2500, which should be deducted from the £19,227. Then they intended supplying the Preston district, the plant for which was estimated to cost £4290; and the expenditure for laying new services and purchasing further meters was computed at £6483—the total estimated cost being £32,500. The report was unanimously adopted, after a little discussion.

The Stockport Gas-Works Extensions.—The Gas Engineer of the Stockport Corporation (Mr. S. Meunier) has made a report to his Committee regarding the alterations and additions at the Portwood gas-works. He says that the first portion of the work in connection with the present extension was commenced by his predecessor (Mr. Jacques) in 1889, and consisted in the erection of a new holder and tank; the storeage capacity being thus increased from 900,000 cubic feet to 2,000,000 cubic feet. When Mr. Meunier took charge of the works, the productive portion consisted of twelve through settings, each containing five retorts, 26 in. by 16 in. internal measurement; and the largest 24 hours' make then recorded was 777,400 cubic feet. Plans were commenced in April, 1891, for an addition of five beds of similar dimensions, but containing six retorts each; one of the beds being fired on the regenerative principle. These were got to work in the winter; the first charge being put in on Nov. 23, 1891, and increased the make considerably. The highest figure reached that season was 1,271,000 cubic feet, on Feb. 12, 1892; all the retorts having been in use throughout the winter. A further addition was authorized; and plans were prepared, and the work put in progress during the summer. In addition, minor alterations were made in the old plant; among them being the re-setting of three of the beds of five 26 in. by 16 in. retorts with seven 23 in. by 17 in. retorts, with the result that a maximum make was obtained on Jan. 18, 1893, of 1,404,700 cubic feet, or a total increase, for the first addition, of 627,300 cubic feet, or 80 per cent. The last portion of the work (three beds of which were started early last week) consists of eight through settings, each containing eight retorts, 23 in. by 17 in. internal section, heated by regenerative furnaces, and is estimated to produce at least 800,000 cubic feet per day; so that the total productive capacity of the works will now amount to about 2,250,000 cubic feet per diem, or a total at all the works of nearly 3,250,000 cubic feet in 24 hours. Other portions of the plant required to deal with this largely increased make have received due attention; and the essential portion of this extension, Mr. Meunier says, may now be taken to be practically complete. The following statement shows the expenditure on the Portwood works from their commencement up to date: Total capital expenditure on the works, from 1876 to December, 1889, £70,090; expenditure on present extensions from 1889 to December, 1893, £38,905—total capital expenditure on the works from 1876 to December, 1893, £108,995.

Increase in the Price of Gas at Wigan.—A recommendation of the General Purpose Committee that the price of gas be increased, from the 1st inst., to 3s. 3d. per 1000 cubic feet within the mile radius from the gas-works, and to 3s. 9d. outside the mile radius, led to a prolonged discussion at the meeting of the Wigan County Borough Council last Wednesday. An amendment to the effect that the proposal be struck out of the Committee's minutes was moved; but finally the recommendation was adopted by 19 votes to 13. The discussion will be noticed at greater length in our next issue.

The Transfer of the St. Petersburg Water-Works to the Municipality.—We are informed by the Secretary of the City of St. Petersburg New Water-Works Company (Mr. F. Grant) that the Douma (Town Council) of St. Petersburg has finally confirmed the accounts of the Company, and fixed the amount of the annuity to be paid at the sum of Rs. 166,601·91 yearly. It has been decided not to commute the annuity at once, but to reconsider the question when the necessity arises of raising a loan for the purpose of carrying out other public works.

Owners' Liability for Arrears of Water-Rates.—At the Thames Police Court last Friday, Mr. E. Hunt, of 35, Tuke Street, Millwall, was summoned by the East London Water Company for neglecting to pay the water-rate due in respect of two houses in Venour Road, Mile End. Mr. Kebbell represented the Company; and it appeared from his opening statement and from the evidence that the defendant had recently purchased the two houses in question. There were four quarters' water-rate due in respect of one house, and eight quarters in respect of the other. It was for these arrears that he was summoned; and he contended that he was only liable for the rates from the time he purchased. The Company, however, submitted that the houses came under Forrest Fulton's Act, by which the rates became a charge on the premises. Mr. Dickinson made an order for defendant to pay the rate, and granted the Company £1 14s. costs.

Stealing Gas at Bradford.—Last Thursday, before the Bradford Borough Magistrates, a woman named Ellen Bunney, residing at 13, Mulgrave Street, was charged with using gas from the Corporation mains without its having passed through a meter. The Town Clerk (Mr. W. T. M'Gowen) stated that on Wednesday in the previous week the meter inspector found that the inlet-pipe on the defendant's premises had been disconnected in two places, and an india-rubber tube fixed, which supplied gas to the rooms above without passing through the meter. For the defence, a son of the defendant stated that the tube was only fixed on the evening preceding the day of the inspector's visit, because the gas would not light, and they had a party at the house. The inspector, however, restored the proper connection; and the gas burned all right. Defendant, who denied all intention of abstracting gas surreptitiously, was fined £1, with 8s. costs, with the alternative of fourteen days' imprisonment.

Buenos Ayres Water Supply and Drainage Company.—An extraordinary general meeting of this Company, which is in liquidation, was held in London on the 22nd ult., for the purpose of hearing a statement as to the winding up of the concern. Mr. H. R. Grenfell, one of the Liquidators, who presided, announced that the share in the general arrangement in which they were interested amounted, in point of fact, to a scaling down of 1 per cent.—that was, from 5 to 4 per cent.—on their bonds for five years. He moved—"That the Liquidators' account laid before this meeting, showing the manner in which the winding up has been conducted and the property disposed of, be and the same is hereby approved; and that the Liquidators be and are hereby authorized and requested to destroy all books and documents which they think unnecessary to be preserved, and to arrange for the safe custody of the remainder for five years, and for their destruction when that time has elapsed." This motion was put to the meeting and passed.

The Tunbridge Wells New Water Scheme.—The proposed site for the new water supply for Tunbridge Wells, in Ashdown Forest, has been visited by several parties of the Corporation, and fine clear water found in abundance. The supply was gauged, and at two conspicuous points proved to be of excellent quality. It was explained that the top-water area of Ashdown Forest is about 45 acres, and the actual water-shed 2300 acres, dependent upon ordinary rainfalls throughout the year, and not upon springs as at Pembury. All the streams meet in a lovely valley, and pass towards Groombridge through woodland scenery. The storeage area will be formed by two natural embankments at an elevation of about 309 feet above sea-level. The waters from the streams will fall by natural gravitation to near Groombridge, and pass through a system of special filtration before reaching Tunbridge Wells. The distance from Groombridge to the storeage dams is eight miles. Mr. J. Mansergh, calculates the supply to be 700,000 gallons, which added to the Pembury and Tangiers sources will yield a total of 1,186,000 gallons per day. Dr. Frankland, who has tested the water, finds it to be of a high degree of organic purity, and most excellent for dietetic purposes. The scheme is estimated to cost £83,050.

Burnley Corporation Gas-Works.—The recommendation of the Gas Committee of the Burnley Corporation to defer for twelve months the erection of a new gasholder at Stoneyholme was rejected by the Council at their monthly meeting last Wednesday. Before the vote was taken, there was a short discussion on the subject, during which it was explained that the reason for the Committee bringing forward such a recommendation was the great expense that was being incurred in the town generally. Those members of the Council who spoke in favour of the work being proceeded with pointed out that, considering the consumption of gas in the town and district, and their holder capacity, they were driving too near the precipice. Alderman Collinge, the Chairman of the Committee, expressed the opinion that the holder space was not sufficient for the requirements of the town; and if they were to have a few foggy days, it would put them in an awkward position. Answering a question, the same speaker said he did not think the supply of the electric light would make 2 per cent. difference in the gas consumption. In 1883, they were consuming 196 million cubic feet of gas, and in 1892 it was 357 millions. Since then they had not put up a single holder. The voting on the question was 21 to 6.

The Price of Gas at Stalybridge.—At the meeting of the Stalybridge Town Council on Monday last week, there was a short discussion with reference to the recent policy of the Gas Committee in raising the price of gas by 6d. per 1000 cubic feet; and an opinion was expressed that it would have been better to advance it by a smaller amount, and to recoup the finances of the department by spreading the recent loss over twelve months instead of one quarter only. Alderman Ridyard explained that the Committee had raised the price by a sufficient amount to cover the loss they had had during the year. They did not want to take into another financial year the liabilities which belonged to this one.

Extension of the Stratford-on-Avon Water-Works.—An inquiry was held at Stratford-on-Avon last Friday by Mr. T. Codrington, of the Local Government Board, relative to an application by the Town Council for permission to borrow £8500 for the purchase of land required for water-works purposes, and £500 for the provision of water-meters. Lengthy statements were made, describing what had been done, and what it was proposed to do, in respect of the water supply. The existing works at Snitterfield, it was mentioned, were carried out some ten years ago. It was now necessary that the Corporation should have greater facilities for storing water, and that the area of the gathering-ground should be enlarged. Owing to want of storeage, the Corporation had been compelled to pump water from a well in the Warwick Road, near to the town, at a very considerable expense, which it was hoped to save by the construction of an additional reservoir. At one time the loss on the undertaking was about £900 per annum; but now it had been reduced to £400. The water cost 1s. 3d. per 1000 gallons; and it was being supplied for trade purposes for 1s. The Inspector observed that this entailed a loss of 25 per cent.; but it was pointed out that it was water which, if not used for trade purposes, would run to waste in consequence of insufficient storeage accommodation. It was asked that the loans should be spread over 50 years. The Inspector intimated that he did not think that was possible. Fifty years was the usual time; but there were some items for which they could hardly grant that period. The water-works were subsequently visited by Mr. Codrington.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 59.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	13 Oct.	10½	Alliance & Dublin 10 p. c.	10	16—17	..	6 3 6
100,000	10	,,	7½	Do. 7 p. c	10	11¼—12¼	..	6 0 0
300,000	100	2 Jan.	5	Australian (Sydney) 5 % Deb.	100	104–106*	+½	4 14 2
100,000	20	14 Dec.	8	Bahia, Limited	20	10—11	..	14 10 10
200,000	5	15 Nov.	6¼	Bombay, Limited	5	5—5¼	..	5 18 2
40,000	5	,,	6½	Do. New	4	3¾—4	—¼	6 10 0
380,030	Stck.	16 Aug.	11½	Brentford Consolidated	100	220—225	..	5 2 2
180,000	,,	,,	8½	Do. New	100	163—168	..	5 1 2
220,000	20	15 Sept	11½	Brighton & Hove Original	20	41—43	..	5 6 11
888,500	Stck.	31 Aug.	5	Bristol	100	102—105	..	4 15 3
320,000	20	29 Sept.	11½	British	20	42—44	..	5 2 3
50,000	10	31 Aug.	11½	Bromley, Ordinary 10 p. c.	10	19—20	..	5 15 0
51,510	10	,,	8½	Do. 7 p. c.	10	15—16	..	5 6 3
328,750	10	28 July	2	Buenos Ayres (New) Limited	10	5½—6½	..	3 1 6
200,000	100	2 Jan.	6	Do. 6 p. c. Deb.	100	95—98*	..	6 2 6
150,000	20	13 July	8	Cagliari, Limited	20	27—28	..	5 14 3
550,000	Stck.	13 Oct.	12½	Commercial, Old Stock	100	244—249	..	5 0 4
165,000	,,	,,	9½	Do. New do.	100	187—192	..	4 19 0
160,762	,,	14 Dec.	4½	Do. 4½ p. c. Deb. do.	100	125—130	..	3 9 3
800,000	Stck.	14 Dec.	13	Continental Union, Limited	100	228—233	..	5 11 6
200,000	,,	,,	10	Do. 7 p. c. Pref	100	195—200	..	5 0 0
535,000	Stck.	15 Sept.	5	Crystal Palace Ord. 5 p.c. Stk	100	100—105	..	4 15 3
486,090	10	28 July	10	European, Limited	10	22—23	..	4 6 11
354,060	10	,,	10	Do. Partly paid	7½	15—16	..	4 13 9
5,646,590	Stck.	16 Aug.	12	Gaslight & Coke, A, Ordinary	100	230—235	+2	5 2 1
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	97—102	..	5 18 5
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	275—280	..	3 11 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	125—135	..	3 14 4
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	185—190	..	3 18 11
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	173—178	..	3 18 7
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	270—275	..	3 12 9
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	164—169	..	3 11 0
1,061,150	,,	14 Dec.	4	Do. 4 p. c. Deb. Stk.	100	127—130	..	3 1 6
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	130—135	..	3 6 8
908,000	,,	,,	6	Do. 6 p. c. do	100	175—180	..	3 6 8
3,800,000	Stck.	15 Nov.	12	Imperial Continental	100	210—215	..	5 11 7
75,000	5	14 Dec.	6	Malta & Mediterranean, Ltd.	5	4½—5	..	6 0 0
560,000	100	2 Oct.	5	Met. of Melbourne, 5p. c. Deb.	100	106—108	..	4 12 7
541,920	20	15 Nov.	5	Monte Video, Limited	20	12¾—13½	..	7 8 2
150,000	5	30 Nov.	8	Oriental, Limited	5	6¾—7¼	..	5 10 4
60,000	5	29 Sept.	7	Ottoman, Limited	5	4—4½	..	7 15 6
166,870	10	—	2	Pará Limited	10	1¾—1¾	..	—
420,000	100	2 Nov.	6	People's Gas of Chicago—1st Mtg. Bds.	100	98—102	..	5 17 8
500,000	100	1 Dec.	6	2nd Do.	100	96—100	..	6 0 0
150,000	10	13 Oct.	5	San Paulo, Limited	10	8½—9½	..	5 5 3
500,000	Stck.	31 Aug.	15½	South Metropolitan, A Stock	100	307—312	..	4 19 4
1,350,000	,,	,,	12	Do. B do.	100	243—248	..	4 16 10
260,000	,,	,,	13	Do. C do.	100	253—258	..	5 0 9
750,000	,,	13 July	5	Do. 5 p. c. Deb. Stk.	100	148—152	..	3 5 9
60,000	Stck.	31 Aug.	11½	Tottenham & Edm'nton, "A"	100	210—215	..	5 7 0
				WATER COMPANIES.				
745,967	Stck.	29 Dec.	10	Chelsea, Ordinary	100	267–272*	+2	3 13 7
1,720,252	Stck.	13 Oct.	8	East London, Ordinary	100	209—214	+1	3 14 10
544,440	,,	29 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	143–148*	..	3 0 9
700,000	50	14 Dec.	8½	Grand Junction	50	109—112	..	3 15 10
708,000	Stck.	16 Aug.	11	Kent	100	287—292	+2	3 15 4
1,043,800	100	29 Dec.	9½	Lambeth, 10 p. c. max.	100	235–240*	..	3 19 2
406,200	100	,,	7½	Do. 7½ p. c. max.	100	196–201*	..	3 14 9
310,000	Stck.	29 Sept.	4	Do. 4 p. c. Deb. Stk.	100	128—131	..	3 1 0
500,000	100	16 Aug.	12½	New River, New Shares	100	345—350	..	3 9 3
1,000,000	Stck.	28 July	4	Do. 4 p. c. Deb. Stk	100	133—136	+1	2 18 10
902,300	Stck.	14 Dec.	6	S'thwk & V'xhall, 10p. c. max.	100	155—160	..	3 15 0
126,500	100	,,	6	Do. D 7½ p. c. do.	100	144—148	..	4 1 0
1,155,066	Stck.	14 Dec.	10	West Middlesex	100	263—267	..	3 14 10

*Ex div.

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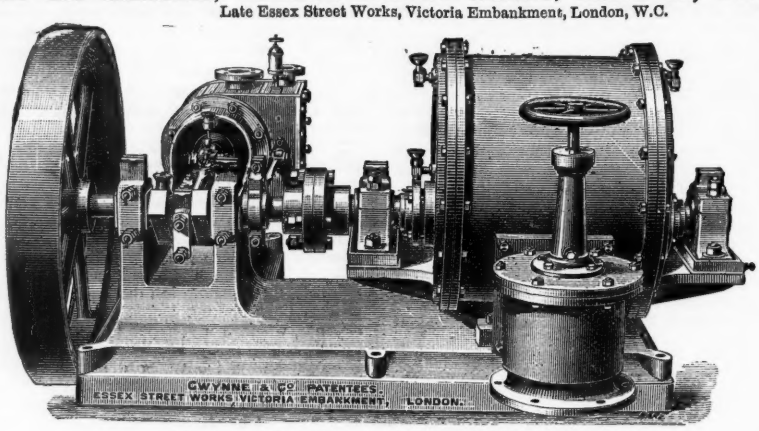

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Testimonials not necessary, but applicants to state shortly their experience, age, and salary expected.
Applications to be lodged with the SECRETARY (J. Gordon Mason, I.I.C.), 23, Queen Street, EDINBURGH, by Saturday, Jan. 13, 1894.

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Applications to be forwarded to No. 2321, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TAR AND AMMONIA WATER.

THE Directors of the Earl Shilton Gas Company are prepared to receive TENDERS for the TAR and AMMONIA WATER made during the ensuing Year, at per ton.
Other information may be obtained or prices sent to E. H. GILBERT, Secretary, Gas Company, EARL SHILTON.

HINCKLEY LOCAL BOARD.
(GAS DEPARTMENT.)

CLERK wanted, used to Gas Companies' Accounts, and able to read Meters.
Apply, stating age and experience, with wages required, to
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Engineer and Manager.

WANTED, to purchase, Gas Carbon, delivered at nearest Station to Gas-Works, in quantities of not less than 4 tons.
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QUOTATIONS wanted at once for a 20,000 and a 30,000 cubic feet per hour STATION METER (new or good second hand). Also OFFERS for the existing 10,000 cubic feet per hour cylindrical STATION METER.
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COUNTY BOROUGH OF SALFORD.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for work required in the ALTERATION OF A GASHOLDER, at the Regent Road Works.
Full particulars may be obtained, and the Drawings may be seen, on application to the Gas Engineer, Gas Offices, Bloom Street, Salford.
Sealed tenders, endorsed "Tender for Gasholder," to be delivered to me, addressed to the Chairman of the Gas Committee, on or before Five p.m., on Thursday the 25th inst.

By order,
SAMUEL BROWN,
Town Clerk.

Town Hall, Salford,
Jan. 3, 1894.

THE Incandescent Gas-Light Company, Limited, whose Registered Office is at 14, Palmer Street, Westminster, give notice that they are prepared to commence immediate PROCEEDINGS against all Persons INFRINGING THEIR LETTERS PATENT, 1885, No. 15,286, granted to Carl Auer von Welsbach for the "Manufacture of an Illuminant Appliance for Gas and other Burners."

FAITHFULL AND OWEN, Solicitors.
11, Victoria Street, Westminster, S.W.

THE Deimel Light Company, Limited, of 86, Gray's Inn Road, London, E.C., give notice that they are DEFENDING PROCEEDINGS which have been instituted by the Incandescent Gas-Light Company, Limited, FOR ALLEGED INFRINGEMENT OF LETTERS PATENT, No. 15,286, of 1885, granted to Carl Auer Von Welsbach.

In such action the validity of the said Letters Patent will be contested.

STEADMAN, VAN PRAAGH, SONS, AND CO.,
Solicitors for the Deimel Light Company, Limited.
23, Old Broad Street, London, E.C.

FENTON URBAN SANITARY DISTRICT.
(GAS DEPARTMENT.)

THE Gas Committee invite Tenders for the supply and delivery of 5000 tons of good GAS COAL or BURGY.

Form of Tender and Particulars may be obtained from the Manager.

Tenders to be sent in on or before Tuesday, the 23rd day of January, 1894, marked "Tender for Coal," addressed to the Chairman, Gas-Works, Fenton.

F. H. DARWIN,
Manager.

Gas Offices, Fenton, Dec. 11, 1893.

THE Gas Committee of the Corporation of Heywood are prepared to receive TENDERS for the supply of RETORTS and FIRE-BRICKS.

Specification, Quantities, and Form of Tender may be obtained upon application to Mr. W. Whatmough, Gas Manager.

Tenders, endorsed "Retorts and Fire-Bricks," to be sent to me not later than Tuesday, the 16th day of January, 1894.

By order,
A. B. PILLING,
Town Clerk.

Municipal Buildings, Heywood,
Dec. 29, 1893.

CORPORATION OF KEIGHLEY.

IRONWORK FOR NEW RETORT-HOUSE.

THE Gas Committee are prepared to receive TENDERS for the following, viz.:—

No. 2 CONTRACT—CAST-IRON COLUMNS, WROUGHT-IRON and ROLLED GIRDERS, &c.
No. 4 CONTRACT—WROUGHT-IRON ROOF.

Copies of Specification, Quantities, and Drawings can be obtained on application to the undersigned, on payment of One Guinea each Contract, which will be returned on receipt of a *bonâ fide* tender.

Sealed tenders, on forms provided for the purpose, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Retort-House," to be delivered at the Gas Offices, Low Bridge, Keighley, on or before Monday, the 15th inst.

By order,
JOHN LAYCOCK,
Engineer.

Keighley, Jan. 2, 1894.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing BY AUCTION of GAS and WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS and WATER SHARES, at the Auction Mart, Tokenhouse Yard, E.C.

His next sale will be held, by order of the Executor of the late Mr. J. F. Mayo and others, at the Mart, on Tuesday, Jan. 16, at Two o'clock precisely, and will consist of Shares in the following Companies:—

Tottenham and Edmonton Gas Company.
Enfield Gas Company.
Barnet District Gas and Water Company.
West Ham Gas Company.
Woking District Gas Company.
Worthing Gas Company.
Ascot and District Gas Company.

Terms for including Shares in these Sales, and all particulars relating thereto, may be had of Mr. Alfred Richards.

Offices: 18, FINSBURY CIRCUS, E.C.

Price 2s. per dozen, or 10s. 6d. per 100, post free.

CONSPIRACY and Protection of Property Act. It is required, under a Penalty of FIVE POUNDS, that a Printed Copy of the 4th Section of this Act shall be posted up at all Gas-Works, in a conspicuous place, where the same may be conveniently read by the persons employed thereat.

Printed copies of this Section, in large type, on broad sheets, may be obtained of WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

*** *The Act extends to Scotland and Ireland.*

THE BRISTOL GAS COMPANY.

IMPORTANT ISSUE OF
GENERAL CAPITAL STOCK
AND
NEW DEBENTURE STOCK.

GEO. NICHOLS, SMITH, & ALDER are instructed to SELL by PUBLIC AUCTION, at their Sale-Room, 49, Broad Street, Bristol, on Thursday, the 1st day of February, 1894, at 2.30 p.m. precisely, in lots of £100 each.

£20,000
FIVE PER CENT. MAXIMUM
GENERAL CAPITAL STOCK
AND
£6250
NEW DEBENTURE STOCK

Bearing Interest at the rate of 4 per cent. per annum, payable half yearly in June and December, of and in THE BRISTOL GAS COMPANY, issued by the Company under their Statutory Powers.

The Stock will be Sold and Registered in the Books of the Company *free of every expense* to Purchasers thereof.

Full Particulars and Conditions of Sale may be obtained of the AUCTIONEERS, 49, Broad Street, BRISTOL; Messrs. BRITTAN, LIVETT, AND MILLER, Solicitors, Albion Chambers, BRISTOL; or of

JOHN PHILLIPS,
Secretary.

Chief Office, Canons' Marsh, Bristol.

HOLMSIDE GAS COALS.
(Wrought out of Holmside and South Moor Collieries.)

PRESENT production 4000 tons per working day. Area of coal about 5000 acres, including the largest remaining workable proportion of pure HUTTON SEAM GAS COAL. Analysis of HOLMSIDE GAS COAL *in bulk as shipped* gives 10,500 cubic feet of Gas per ton, of an Illuminating Power of 16¼ candles. The Sulphur is about 1 per cent., and the Ash 1¾ per cent. The Coal cokes well, and leaves about 70 per cent. of excellent Coke. To show the progress of HOLMSIDE COALS, it may be mentioned that the quantity carbonized by the London Gas Companies in 1885 was about 200,000 tons; whereas the present consumption of HOLMSIDE COALS in London alone is at the rate of nearly

600,000 Tons per Annum.

Full particulars on application to
MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-ON-TYNE.

To effect a great saving in
GAS-FURNACES use our
Special Derbyshire **GANNISTER BRICKS.**
ADDRESS
JAMES WHITE & Co., Limited,
ALBERT WORKS, WIDNES.

LONDONDERRY GAS COALS
FROM THE
MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO
S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

AUG. KLÖNNE,
DORTMUND (GERMANY).

REGENERATIVE FURNACES.

Unsurpassed in
Efficiency, Economy, Durability, and Easy Working.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cubic feet.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.,
B Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

HUNTER'S
OXIDE OF IRON.
JAMES HUNTER, LESSEE, MINER, AND SHIPPER OF
NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
11, BAY STREET, PORT GLASGOW.
Telegrams: "HUNTER PORT GLASGOW."
Established 1872.

THE SILICA FIRE-BRICK COMPANY,
OUGHTIBRIDGE, near SHEFFIELD,
MANUFACTURE
SILICA BLOCKS, BRICKS, AND CEMENT
OF SUPERIOR QUALITY
FOR GAS-FURNACES.
Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their
GREATER DURABILITY
Strongly recommended where EXCESSIVE HEATS have to be maintained.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS, ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
London Office:
90, CANNON STREET, E.C.

Now Ready, Cloth Bound, Price 3s. 6d., Post Free,

THE ROYAL COMMISSION on the METROPOLITAN WATER SUPPLY.

— 1892-3. —

Report of the Evidence (reprinted from the JOURNAL), with Comments on the Inquiry, and the Commissioners' Conclusions and Recommendations.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

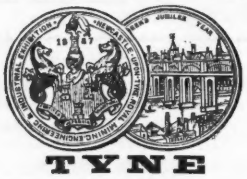
Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.



TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cen't.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

COAL OWNERS, NEWCASTLE-ON-TYNE;

OR

E. FOSTER & CO.,

21, JOHN STREET, ADELPHI, LONDON, W.C.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.,

Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Ipswich Gaslight Company, Devonport Gas Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,

LIMITED,

Newcastle-on-Tyne.

W. H. PARKINSON,

FITTER.

T. B. KITTEL, SHEFFIELD.

CONTRACTS FOR SUPPLIES OF ANY OF THE PRINCIPAL

ENGLISH & SCOTCH CANNELS.

REAL SILKSTONE GAS COAL

ANALYSIS AND PRICES ON APPLICATION

T. B. KITTEL, SHEFFIELD.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON AND COAL COMPANY, Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. Pattinson, Public Analysts for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a Working Analysis made of these Coals by the Tudhoe and Sunderland Bridge Gas Company:—

[COPY.]

TUDHOE AND SUNDERLAND BRIDGE GAS COMPANY.

Tudhoe Gas-Works,
Spennymoor,
8th June, 1893.

Messrs. The

WEARDALE IRON & COAL COMPANY, LTD.

GENTLEMEN,

For the last two months we have used your **THORNLEY GAS COAL** exclusively at these gas-works; and I have pleasure in herewith giving you the actual results obtained during the trial.

Yield of Gas per ton: 10,300 cubic feet.

Yield of Coke: 13½ cwt.

Illuminating Power of Gas, average of a series of tests, **17 Sperm Candles.**

The Coke was of excellent quality.

The following is a complete ultimate Analysis of the Coal.

	Per Cent.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

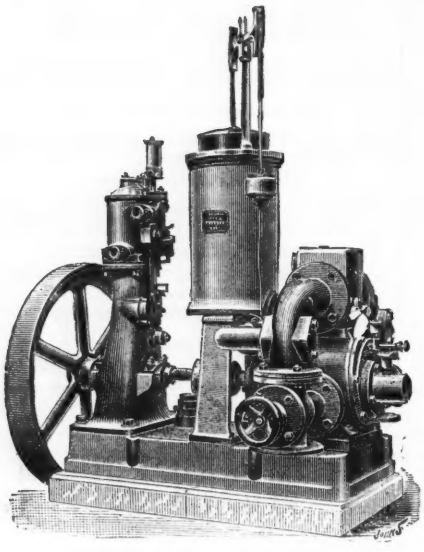
Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
	100·00

I am, Gentlemen,
Yours truly,
A. B. COWAN,
Manager.

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.



WALLER'S PATENT COMBINED GAS ENGINE AND EXHAUSTER

WITH

Disc-Valves, Automatic Bye-Pass Valve, Throttle-Valve, and Regulator,

COMPLETE ON ONE BASE PLATE.

Designed chiefly for sizes from 500 to 15,000 feet per hour.

CAN BE SEEN IN ACTION AT ADDRESS BELOW.

EXHAUSTERS OF ANY SIZE

COMBINED WITH GAS-ENGINES (now made to vary in speed).

ENGINES & EXHAUSTERS RUN AT DIFFERENT SPEEDS

Waller's Washer-Scrubber with Wood Clusters.

ELEVATING AND CONVEYING MACHINERY FOR COAL, COKE, &c.

G. WALLER & CO.,

58, PARK STREET, SOUTHWARK (SURREY SIDE OF SOUTHWARK BRIDGE.)

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
71, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on application.

JAMES OAKES & Co.,
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.
Manufacture and keep in Stock at their Works
(also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas Water, Railway, Telegrapb, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts, and covers, and rendering leakage impossible.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, 23, Alwyne Road, Canonbury, LONDON, N.

Prices are Reduced.

CAST-IRON PIPES
FOR GAS AND WATER.

Pipes, One to Six inch Bore, kept in Stock. Also a very large assortment of all sizes of Bends, T-pieces, and Specials ready for despatch on receipt of Order.

VALVES
FOR GAS, WATER, AND STEAM.

TELEGRAMS: "PIPES GLASGOW."
WM. MACLEOD & CO.,
56, ROBERTSON STREET, GLASGOW.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

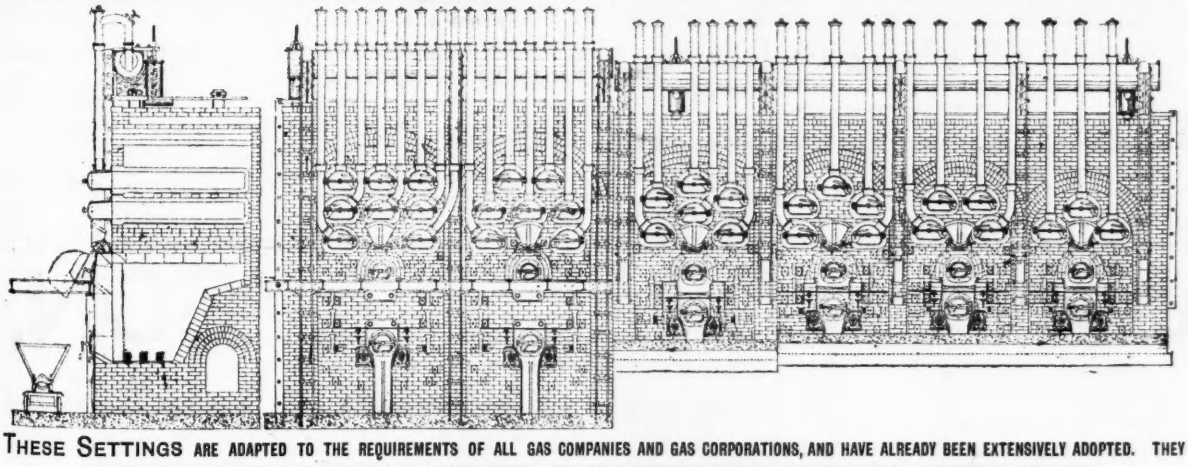
TELEGRAPHIC ADDRESS: "ROBUSTNESS, LONDON." EXCHANGE TELEPHONE 1756.

GASEOUS FIRING
FOR LARGE OR SMALL
RETORT-SETTINGS
PLANS, SPECIFICATIONS,
AND ESTIMATES SUBMITTED.

SPECIALTIES

J. & H. ROBUS,
20, BUCKLERSBURY, LONDON, E.C.
ENGINEERS & CONTRACTORS
FOR THE ERECTION OF GAS AND WATER WORKS
COMPLETE, AND FOR EXTENSIONS AND RENEWALS.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE ADAPTED TO THE REQUIREMENTS OF ALL GAS COMPANIES AND GAS CORPORATIONS, AND HAVE ALREADY BEEN EXTENSIVELY ADOPTED. THEY ARE ERECTED UPON BOTH THE WORKING-STAGE AND SHALLOW-CHAMBER SYSTEMS, AND EQUALLY SATISFACTORY RESULTS ARE GUARANTEED IN BOTH CASES.

THE SETTINGS HAVE ATTAINED TO A MEASURE OF SUCCESS AND POPULARITY QUITE UNEQUALLED BY THAT OF ANY OTHER WITHIN THE SAME SPACE OF TIME. THE WORKING RESULTS OBTAINED, AND THE GENERAL SATISFACTION GIVEN, ARE DECLARED IN EVERY CASE TO EXCEED, AND IN MOST CASES CONSIDERABLY EXCEED, THE PATENTEE'S GUARANTEE. THE CONSTRUCTION AND WORKING OF THE PATENT PRODUCER AND THE PATENT CHARGING APPARATUS FOR SAME ARE ABSOLUTELY UNIQUE AND UNRIVALLED, AND ARE THE DELIGHT OF EVERY STOKER; WHILE IN EVERY OTHER PARTICULAR THEY SECURE THE HIGHEST RESULTS ATTAINABLE BY ANY REGENERATIVE SYSTEM, AND AT A MINIMUM OF COST.

Drawings and Specifications are furnished for the complete erection of Ovens, with or without Retort and Bench Mountings, or complete erection undertaken if required, and carried out by specially Trained Workmen.

Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stewart Street, Shawlands, Glasgow; J. E. FISHER, Stourbridge, and from R. F. HISLOP (son of Patentee), Gas-Works, Paisley.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non* TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED, AND AFFORDING THE HIGHEST SATISFACTION.

SPENT LIMES NO LONGER WASTE PRODUCTS
Under G. R. HISLOP'S PATENTS.

All Spent Limes are most effectually, economically, and continuously recovered at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it.

Descriptive Pamphlets and Terms from Agents as above.

ALEX. C. HUMPHREYS, M.E.,
General Superintendent & Chief Engineer,
The United Gas Improvement Company, U.S.A.

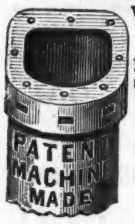
A. G. GLASGOW. M.E.,
Late General Inspector,
The United Gas Improvement Company, U.S.A.

HUMPHREYS & GLASGOW,

Contracting Engineers for Water Gas Plant,
9, Victoria Street, London, S.W.

WILLIAM INGHAM & SONS,

Incorporated with the Leeds Fire-Clay Company, Ltd.,
WORTLEY FIRE-CLAY WORKS,
Near LEEDS,



Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
2. They can be made in one piece up to 10 feet long.
3. Uniformity in thickness, ensuring equal Expansion and Contraction.

PATENT
MACHINE-MADE GAS-RETORTS.

GAS AND WATER PIPES
AND
CASTINGS OF EVERY DESCRIPTION.

MANUFACTURED BY THE

CLAY CROSS COMPANY,
CHESTERFIELD.

TRADE	TELEGRAMS:	LONDON AGENTS:
C X C	"JACKSON"	BECK & Co.,
MARK.	CLAY CROSS.	130, ST. SUFFOLK ST., S.E.

GODDARD, MASSEY, & WARNER'S
IMPROVED
Sulphate of Ammonia Apparatus.

The most successful and approved Apparatus known up to the present time.

FOR REFERENCES, PARTICULARS, TESTIMONIALS, AND PRICE APPLY TO

GODDARD, MASSEY, & WARNER,
ENGINEERS,
NOTTINGHAM.

The Apparatus has been supplied to the following Firms—
BURT BOULTON, & HAYWOOD, SILVERTOWN, and ELING.
CHANCE BROTHERS, OLDBURY (Four Apparatus).
RUNCORN SOAP & ALKALI CO., Limited, RUNCORN.
NETHAM CHEMICAL CO., Limited, BRISTOL.
ANIMAL CHARCOAL CO., Limited, SHADWELL.
WM. BUTLER & CO., BRISTOL.
KEMPSON & CO., Pye Bridge.

And to the following Gas Companies and Corporations—

ILKESTON.	BURY.	CHORLEY.
WIDNES.	BRIGHOUSE.	WHITEHAVEN.
HALIFAX.	MARKET HARBRO'.	CHESTER.
ALTRINCHAM.	PRESCOT.	SOUTH SHIELDS.
DENTON.	SOWERBY BRIDGE.	LEEK.
ST. ALBANS.	LEICESTER.	IPSWICH.
DUKINFIELD.	DARWEN.	BOURNEMOUTH.
NORTHWICH.	NELSON.	SALFORD.
HUDDERSFIELD.	ORMSKIRK.	LUTON.
		HAMPTON COURT.

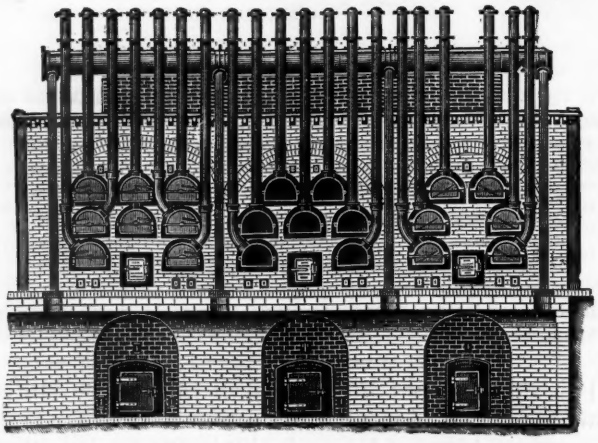
JONAS DRAKE & SON,

TELEGRAPHIC ADDRESSES:
"DRAKESON, HALIFAX."
"ECLAIRAGE, LONDON"

TELEPHONE No. 43.
HALIFAX EXCHANGE.

GAS ENGINEERS,
CONTRACTORS,
IRONFOUNDERS,

BUILDERS AND ERECTORS OF EVERY DESCRIPTION OF OVENS, BENCHES, KILNS, FURNACES, &c.



RETORT SETTERS,
FURNACE BUILDERS
ETC., ETC.

REGENERATOR AND GENERATOR FURNACES ON DRAKE'S, FRITH'S, SIEMENS'S, KLONNE'S, HASSE'S, VALON'S, SOMERVILLE'S, PONSARD'S and other Principles.

INCLINED RETORTS

GASEOUS FIRING A SPECIALTY.

RETORT SETTING IN ALL ITS PRINCIPLES AND BRANCHES. BENCHES FITTED UP COMPLETE.
DRAWINGS, SPECIFICATIONS, AND ALL OTHER PARTICULARS ON APPLICATION.

LONDON OFFICE:
60, QUEEN VICTORIA ST., E.C.

OVENDEN, HALIFAX.

THE WHESSOE FOUNDRY CO., LTD., DARLINGTON.

Established 1790.

MANUFACTURERS OF EVERY DESCRIPTION OF GAS PLANT,

FROM

RETORTS

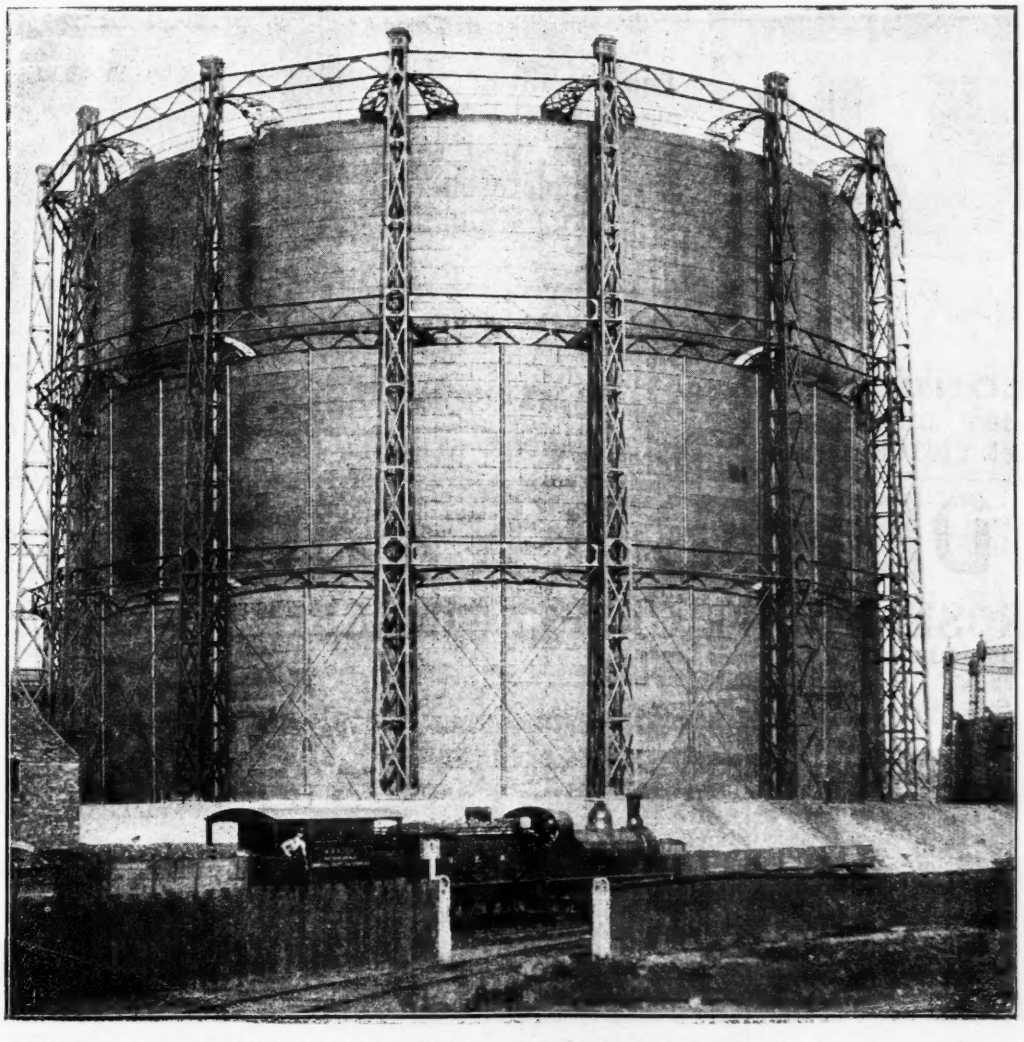
TO

GASHOLDERS,

FOR WHICH THEY HAVE THE NEWEST AND MOST MODERN MACHINERY.

GASHOLDERS CAN BE MADE OF ANY DIAMETER AND PUT TOGETHER AT THE WORKS.

DESIGNED BY V. WYATT ESQ., LONDON.



FOR THE NEWCASTLE AND GATESHEAD GAS COMPANY.

Holders having a capacity of 6,000,000 Cubic Feet have been made and erected; the largest one being 181 feet diameter by 136 feet 9 inches deep. Riveted entirely with $\frac{3}{8}$-inch diameter Hot Rivets.

SOLE MAKERS OF

THE WHESSOE PATENT CENTRE-VALVE

FOR WORKING PURIFIERS.

This Centre-Valve is the cheapest and most effective Valve in the market. Any unskilled workman can understand it; and it costs about half the price of any other Valve. The Purifiers can be worked in rotation or bye-passed singly, or bye-passed altogether; and the Valve can be worked either as a Hydraulic or Dry-Faced Valve.

AND SOLE MAKERS OF

COATES' IMPROVED PATENT FURNACE DOOR PROTECTOR,

Which has been approved and adopted by the Gas Authorities at

SALFORD, MANCHESTER, BIRKENHEAD, STOCKTON, NEWCASTLE, DARLINGTON, &c.

Telegraphic Addresses: WHESSOE, DARLINGTON. WHESSOE, LONDON. | T. COATES, MANAGING DIRECTOR. | WORKS: DARLINGTON. LONDON OFFICE: 28 QUEEN STREET, E.C.

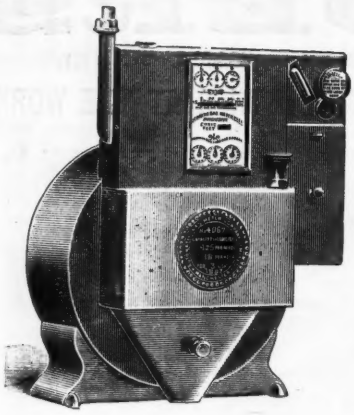
THE AUTOMATIC GAS-METER CO., LTD.,

UPPER BROOK ST., MANCHESTER.

SOLE PROPRIETORS OF

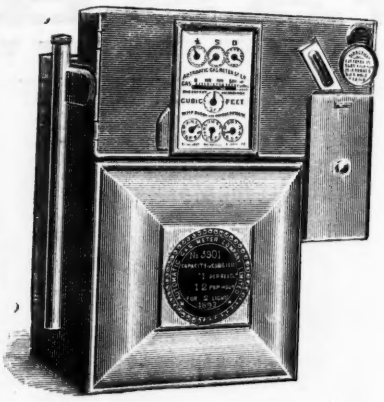
THORP, MARSH, AND HAYNES' PATENTS.

PENNY-IN-THE-SLOT GAS-METERS.



The amount of Gas given in exchange for Coin can be altered *in Situ.*

The amount of Cash placed in the Box is recorded; and this is a complete check against fraud.



PENNY-IN-THE-SLOT GAS-METERS.

PRICES AND FULL PARTICULARS ON APPLICATION.

LONDON: ALBERT BUILDINGS, 49, QUEEN VICTORIA ST., E.C.

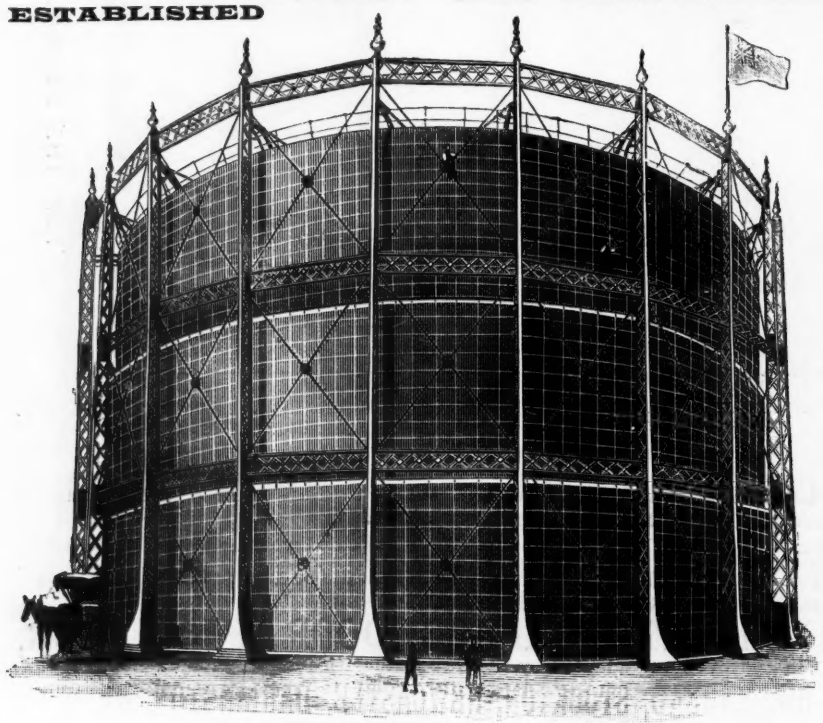
MANCHESTER: UPPER BROOK STREET.

LEEDS: 5, MERRION STREET.

R. DEMPSTER & SONS, Ltd.,

ROSE MOUNT GAS ENGINEERING WORKS,

ESTABLISHED **1855.**



RETORT-FITTINGS,
CONDENSERS,
EXHAUSTERS,
PURIFIERS,
SULPHATE PLANTS,

AND EVERY DESCRIPTION OF

Gas and Chemical Plant.

ELLAND.

The above illustrates a TREBLE-LIFT GASHOLDER, 194, 191, and 188 feet diameter by 85 feet deep each, as made for the MELBOURNE GAS COMPANY.

The Gasholder sheets are levelled by machinery, and are afterwards sheared, squared, and punched by an Improved Combined Multiple Punch and Shearing Machine, which also punches the circumferential seams of crown sheets by special punches and dies, ensuring perfect accuracy, avoiding rimering in erection.

HEATHCOTE GAS COAL.

RICH IN ILLUMINATING POWER AND YIELD OF GAS.
ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.
MAINTAINS A HIGH STANDARD IN RESIDUALS.

THE GRASSMOOR Co., Ld., CHESTERFIELD.

CLAYTON SON & Co. LTD

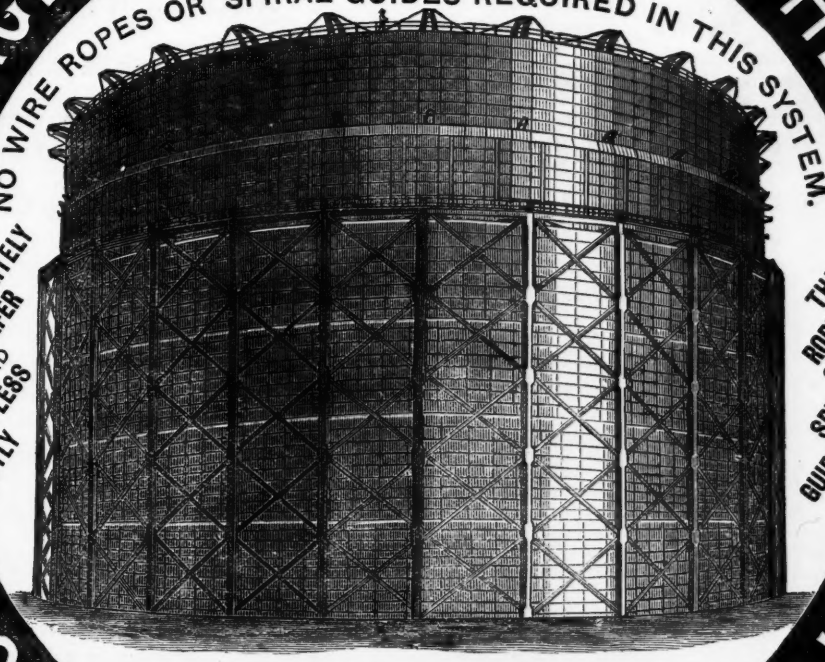
MAKERS OF

WORKS LEEDS

THE LARGEST GASHOLDER IN THE WORLD

GASHOLDERS OUR SPECIALITY

NO WIRE ROPES OR SPIRAL GUIDES REQUIRED IN THIS SYSTEM.



INFINITELY SAFER AND FAR LESS COSTLY THAN ROPES OR SPIRAL GUIDES.

CAPACITY 12 MILLION CUBIC FT.

ERECTED AT EAST GREENWICH FOR THE South Metropolitan Gas Company
IT HAS SIX LIFTS 30 FT DEEP EACH AND IS 300 FT DIAR

MAKERS OF GAS PLANT OF EVERY DESCRIPTION
ROOFS PURIFIERS &c. ALSO

ADDRESS LONDON 60, QUEEN VICTORIA ST.
TELEGRAPHIC "GAS, LEEDS."
GASHOLDERS OF ANY SIZE

ERECTED & COMPLETED WITHIN 12 MONTHS AND AT THE TIME SPECIFIED

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 feet of 19-candle gas per ton.
Weight of illuminating power in pounds of sperm, 820·80. Very free from impurities.
Telegrams: "ATLAS SHEFFIELD."

IMPORTANT TO ENGINEERS AND GAS COMPANIES.

A NEW CARBURETTOR FOR ENRICHING GAS IN BULK.

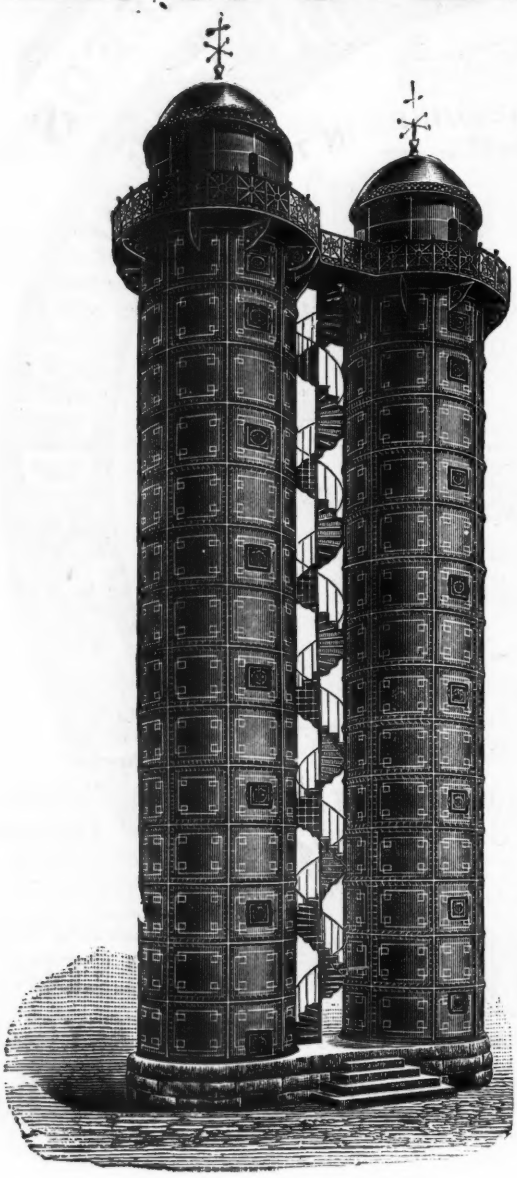
The Carburettors have been doing practical work for the past two years; in many cases doing all the enrichment without the use of Cannel or other rich Coals. The South Metropolitan Gas Company have these Enrichers at all their Stations. The Gaslight and Coke Company have had them in use at some of their principal Works for two years past; and several more are now being fixed at their other Stations. The Carburettors are also in use at several Suburban and Provincial Gas Companies' Works.

FOR PRICES AND FULL PARTICULARS, APPLY TO

THE GAS LIGHTING IMPROVEMENT COMPANY, LIMITED,

18, DEVONSHIRE STREET, BISHOPSGATE, LONDON.

R. & J. DEMPSTER,



ENGINEERS, IRONFOUNDERS,

AND CONTRACTORS,

Gas-Plant Works, Newton Heath, MANCHESTER.

TOWER SCRUBBERS WITH PLANED JOINTS OF HANDSOME DESIGN.

Messrs. R. & J. D. wish to specially direct the attention of Gas Managers to the larger quantity of Ammoniacal Liquor or Sulphate **made** by their Scrubbers than by any of the numerous Rotary and other Machines now upon the market. From 28 lbs. to 34 lbs. of Sulphate are produced (per ton of coal carbonized) by their Scrubbers; whereas 20 lbs. to 22 lbs. is as much as can be got by the Machines. Gas Managers with low yields of Sulphate should not rest satisfied (because Ammonia does not show on test papers) until they are getting all the Ammonia it is possible to make. It should be remembered that each gallon of liquor, or 1 lb. of Sulphate, is worth about 1d.; thus, when every ton of coal carbonized is multiplied by 6d., 8d., 10d., or 1s., from increased yield of Sulphate on the quantity of coals used per annum a very large extra profit is made. Irrespective of the profit made from the increased yield of Ammonia, these Scrubbers utilize the Ammonia as a purifying agent, and very considerably reduce the amount of work to be done in the purifiers.

London Offices:

181, GRESHAM HOUSE, OLD BROAD ST., E.C.

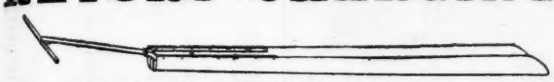
STOURBRIDGE RETORTS AND FIRE-BRICKS.

BEST QUALITY.

KING BROTHERS, STOURBRIDGE.

[See Illustrated Advertisement, Jan. 2, p. 41.]

STEEL SCOOPS FOR RETORT CHARGING.



Scoops supplied with or without handles, and of any dimensions or shape required.

HENRY SYKES, Engineer,
66, BANKSIDE, LONDON, S.E.

TELEGRAPHIC ADDRESS "GAS LEEDS." CO. QUEEN VICTORIA STREET, E.C. LONDON OFFICE.

CLAYTON, SON, & Co.

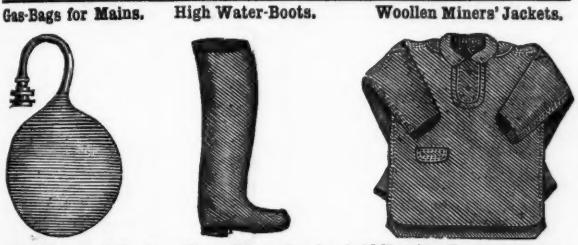
LIMITED,
LEEDS,
MAKE

RETORT LIDS

OF ALL FORMS AND SHAPES
IN IRON OR STEEL
BY SPECIAL HYDRAULIC MACHINERY.

PRICES ON APPLICATION.

Gas-Bags for Mains. High Water-Boots. Woollen Miners' Jackets.

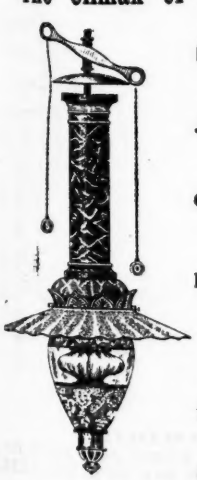


Delivery and Suction Hose, Gutta-Percha Acid Bottles, Leather Driving Bands, Woven Canvas Hose for Fire-Engines, Wedge and Square Gas-Bags, Air and Water Beds for Invalids, Oil Tarpaulin Coats, Trousers, Hats, &c., Squeegees for cleansing Pavements, &c., Billiard and Bagatelle Cush, Tricycle Tyres, Leather Hose, Cotton Waste, Engine Cloths, Oils, &c., India-rubber Waterproof Garments for Walking, Driving, or Sporting Wear, Diving and Wading Dresses, Printers' Blankets, Iron Wheels and Rollers covered with India-rubber. Stokers' Gloves, 14s. 6d. per dozen.

Write for Price List to

THOMAS BUGDEN, Manufacturer,
71, GOSWELL ROAD, LONDON, E.C.

The Climax of Regenerative Gas Lighting!!



THE

"VERTMARCHE"

A 280-CANDLE POWER
PLAIN IRON LAMP,

CLASS A— **55/-**

LIGHT for LIGHT
less than half the price of any other Regenerative Lamp.

Manufactured in England by

HENRY GREENE & SONS,

153 & 155, CANNON STREET,
LONDON BRIDGE, E.C.

PARTICULARS AND PRICES FREE. AGENTS WANTED.

IRISH OXIDE OF IRON.

GAS PURIFICATION.

RIKY'S OXIDE (formerly worked by Messrs. Stanley and Olphert).

THE LARGEST SUPPLY OF OXIDE IN HAND OF ANY OTHER FIRM IN THE WORLD.

Purity and Uniformity of Quality Guaranteed.

RIKY AND CO. can supply the above at a much lower rate than any other firm in the trade, being owners of the property where it is found. *No Middleman or Agent* receives a profit.

SAMPLE AND PRICE ON APPLICATION.

Address JOHN RIKY AND CO., Killygordon, County Donegal; and 193, Great Brunswick St., Dublin. Telegrams: "RIKY, KILLYGORDON."

HARPER & MOORES,

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MANUFACTURERS OF

BEST FIRE-BRICKS, GAS-RETORTS,
LUMPS, TILES, AND ALL ARTICLES IN FIRE-CLAY.

Proprietors of Best Glasshouse Pot, Crucible, and other Stourbridge Clays.

MANUFACTURERS OF GLASSHOUSE POTS AND CRUCIBLES OF EVERY KIND.

ESTABLISHED 1836.

OSLER,

BIRMINGHAM.

MANUFACTURERS
OF GASELIERS
IN GLASS AND METAL.

ARROL-FOULIS

Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,
GLASGOW.

See Illustrated Advertisement, p. II. Centre of JOURNAL for Jan. 2.

JOSEPH CLIFF & SONS,

INCORPORATED IN
THE LEEDS FIRE-CLAY COMPANY, Ltd.,
WORTLEY, LEEDS.

LONDON Offices & Depôts:
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WHARVES NOS. 2 & 4, INSIDE G.N. GOODS YARD, KING'S CROSS, N.

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LEEDS:
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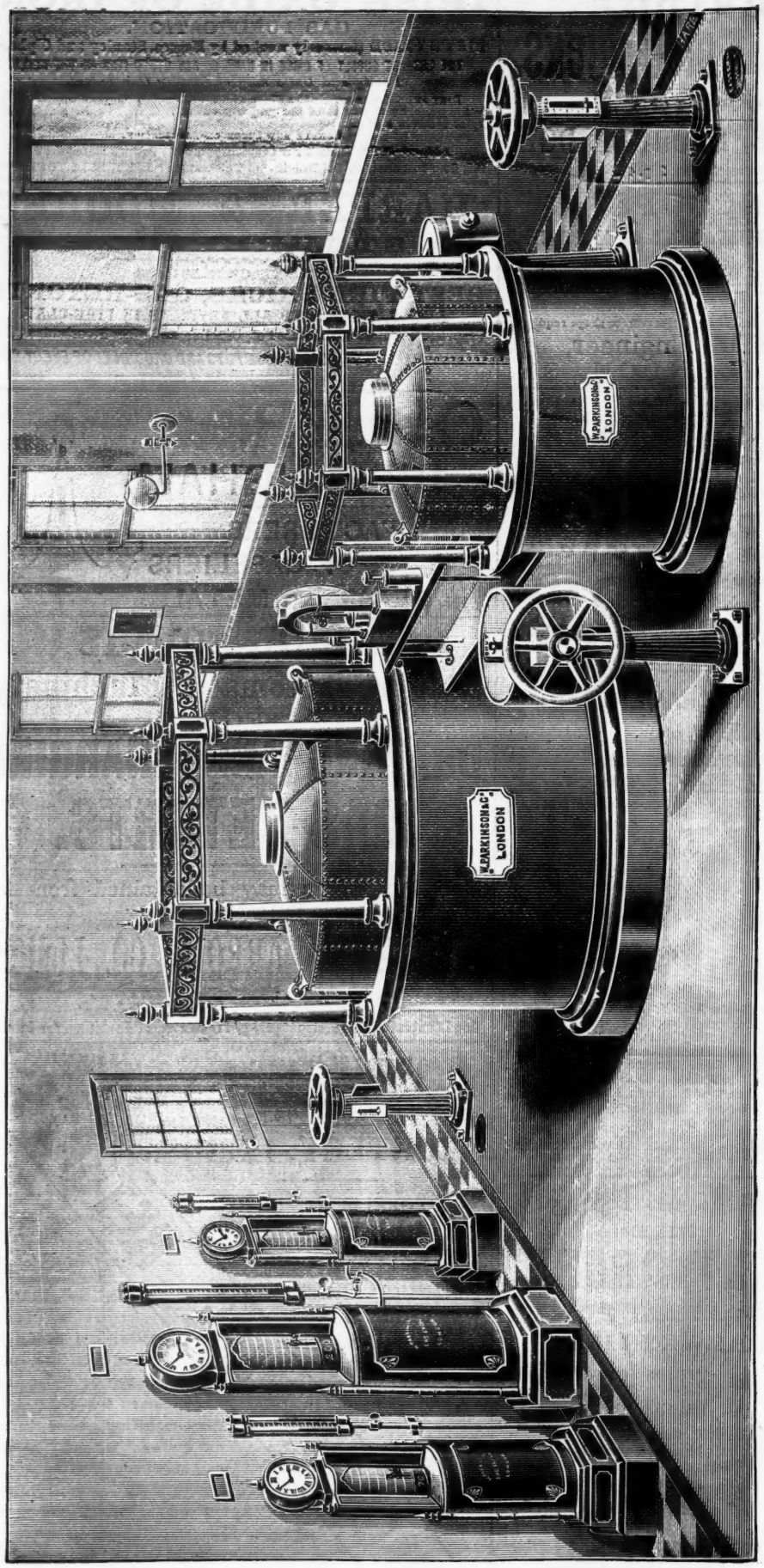
MACHINE-MADE RETORTS

Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.



EQUILIBRIUM GOVERNORS, THE GASLIGHT AND COKE COMPANY'S VALVE-ROOM, STOKE NEWINGTON.

(TESTIMONIAL.)

THE GASLIGHT AND COKE COMPANY, 146, *Goswell Road, E.C., Jan. 5*, 1893.

GENTLEMEN,—In reply to your inquiry as to the working of the 36-inch and 24-inch Governors (double cone and equilibrium) recently erected by you at the new Valve-Station of this Company, situated at Stoke Newington, I beg to inform you they are highly satisfactory in their working.

The gas governed is supplied through a high-pressure pumping-main; and, notwithstanding the great fluctuations in the initial pressure, owing to so many stations pumping and shutting off alternately, the construction of your Governors enables a perfect equilibrium to be maintained, and being acted upon themselves by outlet pressure only, they stand the most severe tests to perfection.

I shall be happy to answer any questions, or show the Governors to Engineers contemplating their erection.

I am, Gentlemen, Yours faithfully,
(Signed) G. F. L. FOULGER, *Distributing Engineer.*

MESSRS. W. PARKINSON AND CO.,
Cottage Lane, City Road, E.C.

W. PARKINSON & CO., LONDON, BIRMINGHAM, MANCHESTER.

[See also Advt. p. 56.

LONDON: Printed by WALTER KING (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Jan. 9, 1894.